International Marine Engineering

FEBRUARY, 1909.

MAGNETIC SURVEY YACHT CARNEGIE.

Except for a few more or less isolated and incomplete surveys, independently undertaken by various nations and distributed over a great many years, little attempt had been made up to four years ago to determine accurately the magnetic variations all over the deep-water seas. Something over four years ago the Carnegie Institution of Washington undertook this work, organizing a department of research in terrestrial magnetism, and placing the entire work under the directorship of Dr. L. A. Bauer, who was formerly in charge of the Magnetic Survey of the United States under the Coast and Geodetic Survey.

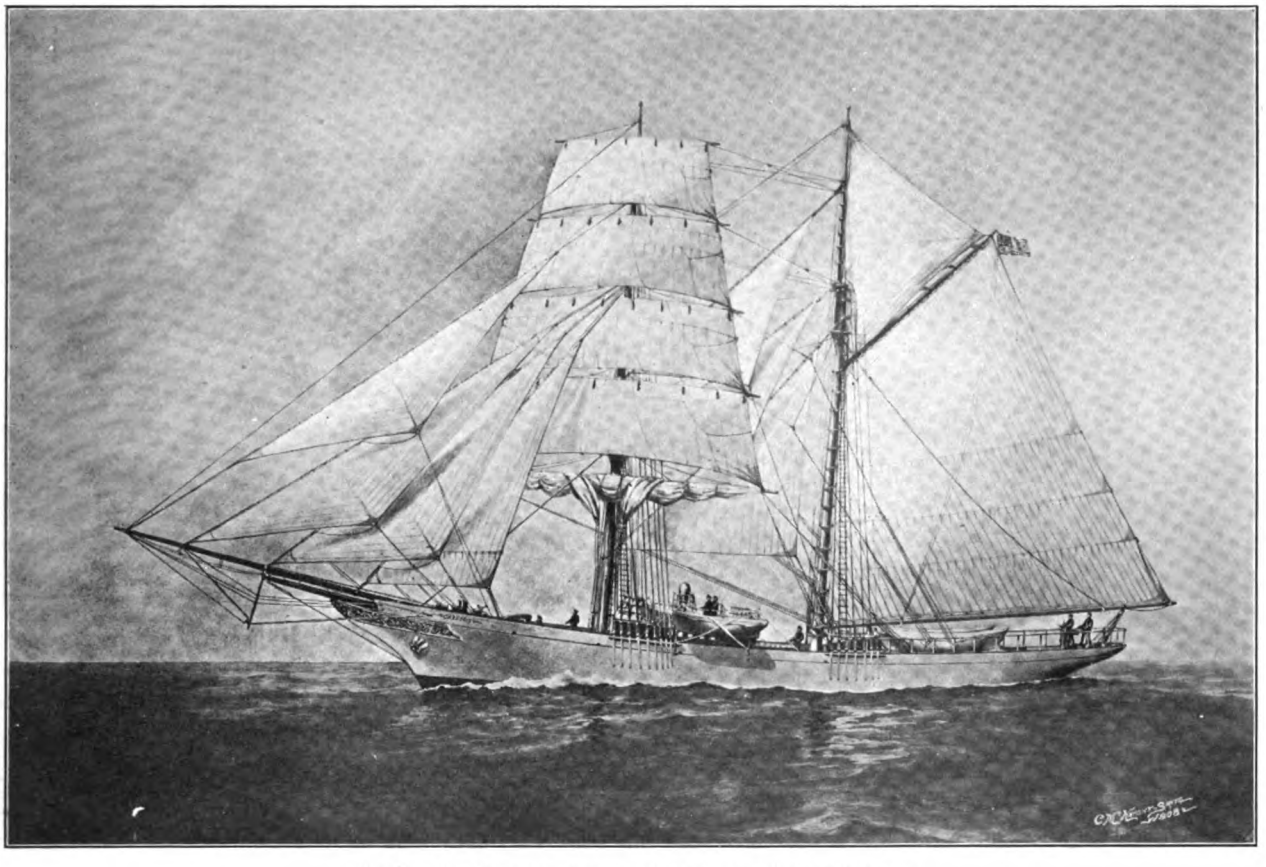


FIG. 1.—THE CARNEGIE AS SHE WILL APPEAR WHEN COMPLETED.

The first step in the ocean work was to make a magnetic survey of the Pacific Ocean, where little had been done except making shore observations on some of the islands and along the coast. Observations were made from the converted wooden yacht *Galilee*, which, between Aug. 1, 1905, and May 31, 1908, or in somewhat less than three years, made three successive voyages in the Pacific, tracing the Great Circle route, and zigzagging in and out among the islands, making the total length of these cruises over 60,000 miles. The most northerly point visited by the *Galilee* was Sitka, Alaska, and the most southerly one was Lyttleton, New Zealand. This is only the beginning of the work, however, as the Institution has already made magnetic observations in many parts of the globe, and now has two expeditions in Africa, one in China, one in Persia and Asia Minor, and has already covered a part of South and Central America, British North America and Greenland. It is estimated that a magnetic survey of the world can be completed in about ten years more.

With the experience gained with the *Galilee* it was proved that for the most economical, expeditious and satisfactory execution of this work, it would be advantageous to have constructed a thoroughly non-magnetic yacht with auxiliary power, and every detail arranged especially for making magnetic observations. The building of such a vessel was authorized by the Carnegie Institution, and the matter of design was

Generated on 2024-09-12 07:39 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

placed in the hands of Mr. Henry J. Gielow, naval architect, of New York. The contract for the yacht, which is to be named the *Carnegie,* was placed with the Tebo Yacht Basin Company, of Brooklyn, N. Y., Dec. 9, 1908.

The design of the boat is unusual in two respects: First, since the nature of the work for which she is intended requires that the entire structure shall be practically non-magnetic, she will be the first vessel in the construction of which iron and steel and other magnetic metals will practically have no part; in other words, with the exception of thin cast-iron liners in the cylinders of the bronze internal combustion engine, and the steel cams necessary for operating the valves, aggregating less than 600 pounds, there will be no magnetic materials used in the construction of the vessel. Second, she will be the first vessel of any size and importance in America to be propelled by producer gas.

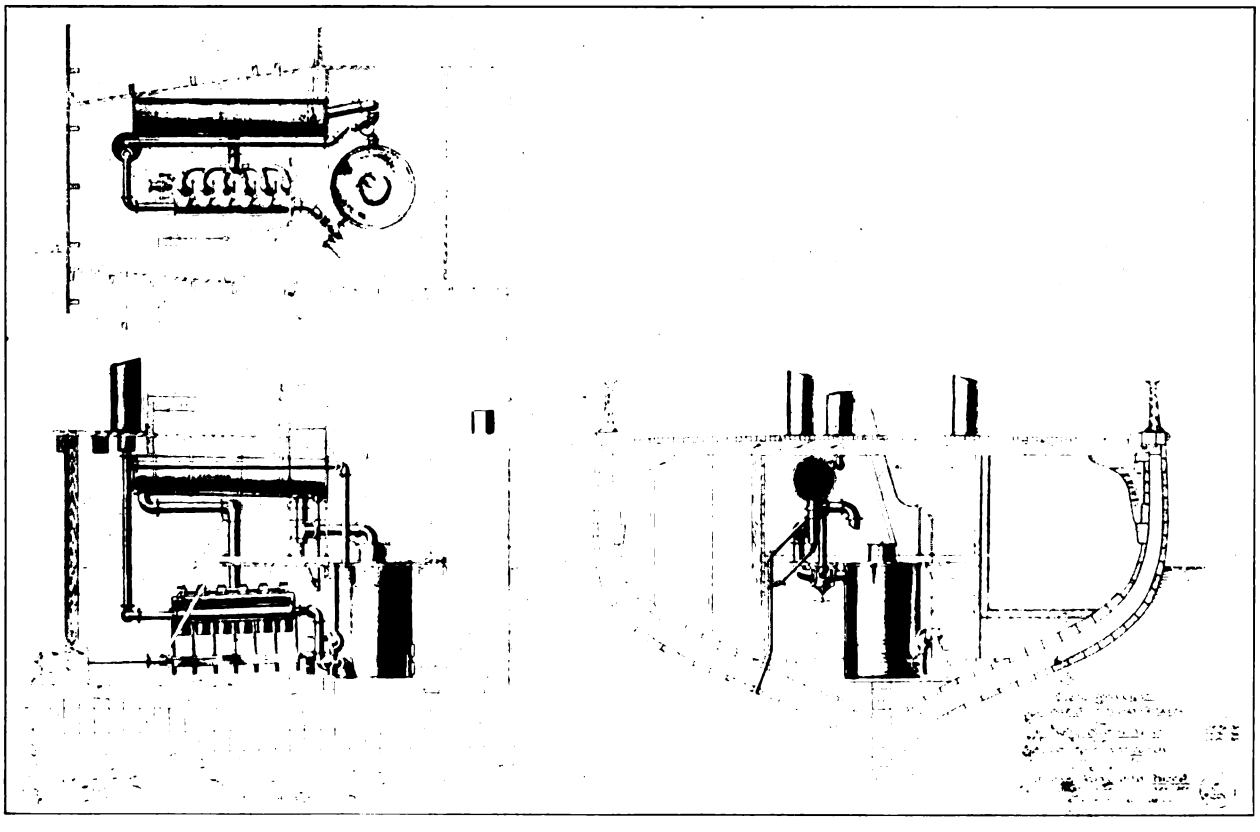


FIG. 2.—SECTIONS THROUGH THE MACHINERY SPACE, SHOWING THE ARRANGEMENT OF THE GAS PRODUCER AND ENGINE.

As the *Carnegie* is intended for ocean surveys, it was decided to build her of the very best materials and make her construction thoroughly substantial, combining the finish and workmanship of a yacht with the sturdy strength of a merchant vessel. Her principal dimensions are as follows: Length over all, 155 feet 6 inches; length on load waterline, 128 feet 4 inches; beam, molded, 33 feet; depth of hold, 12 feet 9 inches; mean draft, 12 feet 7 inches. With all stores and equipment on board, the yacht has a displacement of 568 tons. Her lines are fair and easy, running in an unbroken sweep from stem to stern. In fact, the model shows power and seagoing qualities throughout.

The hull will be constructed as thoroughly and substantially as any merchant vessel afloat, the scantlings being the same as those required by the American Bureau of Shipping for merchant vessels of equal tonnage. The keel, stem, stern post, frames and deadwood will be of white oak; the deck beams, planking and ceiling will be of yellow pine, and the deck of Oregon pine in long lengths, comb-grained. The keel is 12 by 14 inches, and to this is fitted a false keel, 12 inches by 8 inches. There are two center keelsons, each 12 by 14 inches, and two assistant keelsons, 12 by 12 inches. The garboard strakes are 6 by 12 inches, rabbeted into the keel. The planking on the bottom is 3 inches thick; at the bilge 4 inches, and on the sides 3½ inches. The ceiling in the bottom is 3 inches thick, at the bilge 6 inches, and on the sides 4 inches. The main deck beams are 8 by 10 inches, with a crown of 3½ inches at the center of the ship. They are joined to the frames with hackmatack knees with 8-inch siding. The fastenings will consist of locust treenails, copper and Tobin bronze bolts and composition spikes, all through bolts to be riveted over rings, both inside and outside. All metal deck fittings and the metal work on the spars and rigging will be of bronze, copper and gunmetal.

The vessel will have full sail power with a brigantine rig, carrying just under 12,900 square feet of plain sail. Her spar plan measures 122 feet from foremast truck to the water surface, and 201 feet from the forward end of the bowsprit to the aft end of the main boom. The distance from the forward end of the bowsprit to the forward end of the load-waterline is 48 feet; from the forward end of the load-waterline to the foremast 35 feet; from the foremast to the mainmast 48 feet.

The rigging will be of Russian hemp, of special make.

It was decided to install auxiliary power in the yacht, in order to provide headway when taking off-shore observations, where the vessel would be handled with difficulty by the sails, or to prevent interference with the observations by maintaining a headway during calms. The necessity of installing an auxiliary power plant which would be nearly non-magnetic in character, made the selection of the type of this plant a somewhat difficult matter. Steam was precluded on account of the necessarily high magnetic nature of a steam plant. The only

Generated on 2024-09-12 07:37 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

type of prime mover which could be commercially built and maintained in reliable operation with a minimum of non-magnetic metals in its construction, appeared to be an internal combustion engine.

Consideration of the available fuel for such a motor resulted in the elimination of gasoline or oil, not only on account of cost, but also because they would be absolutely unavailable in the zones to be covered by the *Carnegie*, and dangerous in

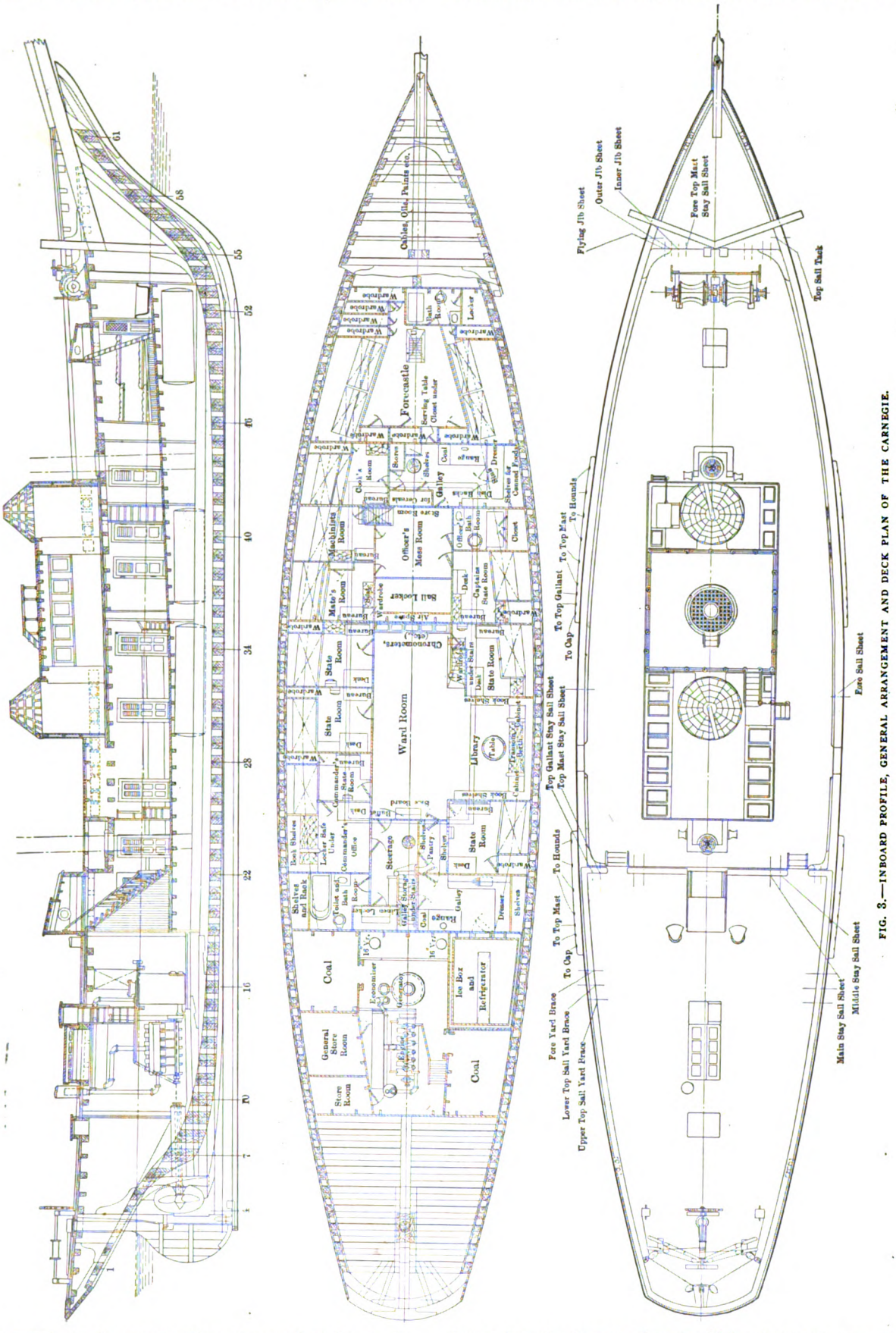


FIG. 3.—INBOARD PROFILE, GENERAL ARRANGEMENT AND DECK PLAN OF THE CARNEGIE.

Generated on 2024-09-12 07:33 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

the quantities which would have to be stored for the lengthy voyages which are contemplated. It is well known that many thousands of horsepower are being developed with internal combustion engines on land, using gas generated from solid fuels. A careful investigation developed the fact that a marine gas producer could be built which would generate a suitable gas for use in internal combustion engines from bituminous or anthracite coal, coke, wood or charcoal, and that such a plant could be constructed almost entirely of non-magnetic material. The suction type of gas producer was adopted principally for the reason of its simplicity in construction and operation, and the elimination to a minimum degree of other auxiliary apparatus.

The gas producer, which is being built by the Marine Producer Gas Power Company, 2 Rector street, New York, will consist of a cylindrical copper shell, lined with a special grade of firebrick. A shaking grate of manganese steel will be supported in the shell at a suitable distance from the bottom of the generator. This grate will support the fuel bed, and will be accessible through a large cleaning and ashpit door.

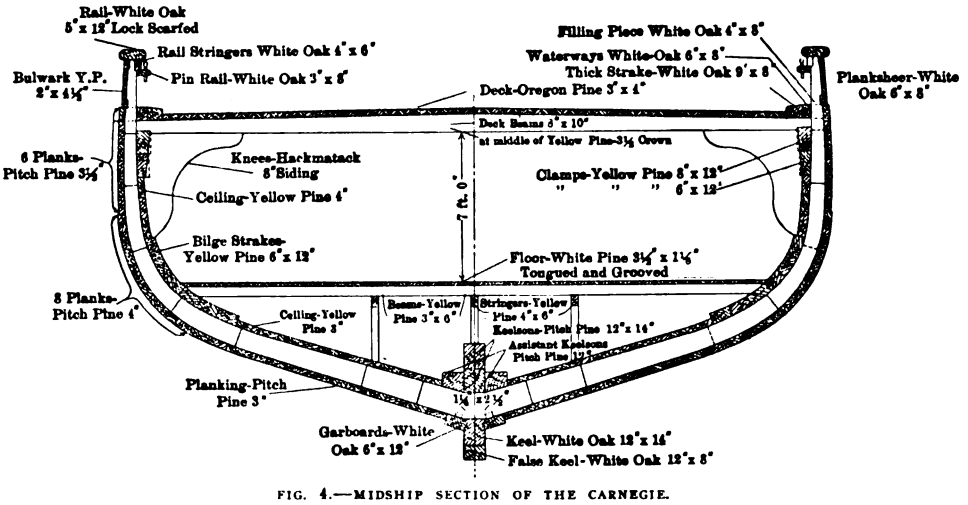

Rail-White Oak
5" x 12" Lock Scarfed
Rail Stringers White Oak 4" x 6"
Pin Rail-White Oak 3" x 8"
Bulwark Y.P.
2" x 4½"
Filling Piece White Oak 4" x 8"
Waterways White-Oak 6" x 8"
Thick Strake-White Oak 9" x 8"
Plankasheer-White Oak 6" x 8"
Deck-Oregon Pine 3" x 4"
Deck Beams 8" x 10"
at middle of Yellow Pine-3½ Crown
6 Planks-Pitch Pine 3½"
Knees-Hackmatack 8" Siding
Ceiling-Yellow Pine 4"
Clamps-Yellow Pine 8" x 12"
" " " 6" x 12"
7 ft. 0"
Bilge Strakes-Yellow Pine 6" x 12"
Floor-White Pine 3½" x 1½" Tongued and Grooved
8 Planks-Pitch Pine 4"
Ceiling-Yellow Pine 3"
Beams-Yellow Pine 3" x 6"
Stringers-Yellow Pine 4" x 6"
Keelsons-Pitch Pine 12" x 14"
Assistant Keelsons Pitch Pine 12"
Planking-Pitch Pine 3"
1¼ x 2½"
Garboards-White Oak 6" x 12"
Keel-White Oak 12" x 14"
False Keel-White Oak 12" x 8"

FIG. 4.—MIDSHIP SECTION OF THE CARNEGIE.

The door frames will be riveted to the shell, and will be of non-magnetic metal, as will also the door. The firebrick lining of necessary thickness and quality will extend to the top of the generator.

The generator will be covered with a heavy copper circular plate, at the center of which will be located an improved fuel-charging mechanism. This will be made of manganese bronze. A manganese bronze gas outlet nozzle will be attached to the producer shell at the top. A hand-propelled fan of brass will be attached to the bottom of the generator by means of suitable brass piping and fittings. During a stand-by, or when starting, the gas generated will pass from the outlet nozzle through a special purge valve of manganese steel to an escape vent, which will be of copper, and will communicate with a short copper stack fitted to the main deck at the after end of the engine room.

When the plant is in operation the gas will pass through the purge valve directly into a special cooling and cleansing mechanism, which will be slung fore-and-aft to the under side of the engine room deck beams by means of manganese bronze straps.

Water for cooling and scrubbing the gas will be supplied by a special bronze pump attached to the engine shaft. This water, together with the dirt and ash washed from the gas, will drain from the lowermost point of the scrubber. The scrubber will be made of heavy sheet copper, and all of the fittings and gas piping connecting with it will be of copper or manganese bronze. The gas will leave the scrubber at its after end, and will be drawn, together with the necessary amount of air for its proper combustion, directly into the cylinders on the suction stroke of each of the pistons.

The generator will have a capacity to gasify 160 pounds of anthracite pea coal per hour, producing a fixed, well-cleaned gas, containing 80 percent of the heat units contained in the coal. As provision is made for carrying 25 tons of coal, the yacht will have a cruising radius of about 2,000 miles at a speed of 6 knots.

The engine will be of a type now commonly found in marine service, having six single-acting cylinders. It is designed to develop 150 brake-horsepower at 350 revolutions per minute. The engine will be started by compressed air, which will be stored in copper tanks under 250 pounds pressure. The air will be furnished by a small air pump attached directly to the engine frame. The only alteration in the engine necessary to make it operative on producer gas will be the elimination of the carburetor and the substitution therefor of a gas and air mixing valve, an increase in the size of the inlet valves, ports and piping, and an increase of compression from 70 to 80 pounds per square inch on gasoline to 150 pounds per square inch on producer gas.

The cylinders, water jackets and heads of the engine will be made of brass. The cylinders will each be fitted with a thin cast-iron liner, to act as a wearing surface for the pistons and rings. Both inlet and exhaust valves will be of bronze, and the latter will be arranged for an internal circulation of cooling water. The wearing surfaces of the pistons will be of cast iron. The cylinders will be mounted on a stanchion-type frame, which will be made of manganese bronze. The engine base, connecting rods, valve stems, igniter box, etc., will also be of manganese bronze. The wrist pins and crank shaft will be made of manganese shaft bronze, a material which has very low magnetic qualities. Any manganese steel used in the construction of the engine will have to be ground to a finish, as it is impossible to machine-tool this material on account of its hardness. The valve cams and rollers will be made of tool steel, hardened and ground. The manganese steel and cast iron, above referred to, will be the only magnetic materials entering into the construction of the engine.

A feathering propeller of special design will be fitted. This will also be constructed of manganese bronze.

The living quarters are all below, ventilation and light being obtained by means of a cabin trunk on the main deck, 42 feet 8 inches in length, 16 feet 6 inches in width and 3 feet in height; heavily constructed of teak wood, finished bright. Skylights, companionway hoods and other wooden deck fittings will all be constructed of teak wood. All hatches will be fitted

Generated on 2024-09-12 07:34 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

with locking devices to secure safety in a seaway. In addition to this the vessel will be sub-divided into seven watertight compartments by means of six transverse bulkheads, so that, with even two compartments stove in, the vessel will still remain afloat.

Immediately aft of the collision bulkhead will be the forecastle, 19 feet 6 inches in length and extending the full width of the vessel, fitted with wardrobes, berths, lockers and ample storage room for eight men. In addition to this there will be a toilet room with bath tub, wash basin, etc., with open, non-magnetic plumbing complete. Immediately aft of the forecastle will be the crew's galley, 8 feet in length by 16 feet athwartships, with range, dresser, sink, shelves, dish rack, bins and storeroom complete. Abreast of the galley, on the port side, will be a double stateroom, with two berths, for the use of the cook and mess man. Aft of the galley and occupying a space of 14 feet 6 inches, will be the officers' mess room, captain's stateroom, mate's stateroom, machinist's room and a toilet and bath room, with bath tub, wash basins, etc., and all plumbing complete. Each stateroom will be fitted with a berth, having drawers underneath, wardrobe and bureau with mirror; the captain's stateroom in addition to this will be fitted with a desk.

Next abaft the officers' quarters are the accommodations for the scientific staff, occupying the full width of the vessel for a length of 38 feet 6 inches; consisting of a ward room 25 feet in length by 11 feet 6 inches in width; three staterooms and the commander's office on the port side, and two staterooms and a library on the starboard side. On the starboard side there will be a mahogany stairway leading to the observation room on deck. In the forward end of the ward room will be a chronometer cabinet and instrument case. Each stateroom will be fitted with a berth with drawers underneath, a large wardrobe, a bureau with mirror, a desk and a folding wash basin, in addition to an upholstered seat with locker underneath. Abaft of the ward room will be the steerage, with a companionway and stairs leading to the deck. On the starboard side will be a galley with all fixtures complete, and on the port side a toilet room with bath tub, wash basin and all plumbing complete. The floor and walls will be tiled. The desks, bureaus, fronts of berths and seats will be of mahogany, finished bright; the doors will be paneled, and, like the bulkheads, will be constructed of white pine, finished in white enamel paint.

Aft of the galley on the starboard side will be an ice-making and refrigerating plant of the ethyl chloride type, constructed throughout of bronze, brass, copper and composition; the whole of sufficient size and capacity to insure a liberal ice supply and ample refrigeration.

Fresh water will be carried in wooden tanks fitted under the cabin and forecastle floor, having a capacity of not less than 6,000 gallons, all properly connected and fitted with piping to all parts of the vessel. The balance of the space under the cabin floor will be arranged in bins and compartments for the storage of various supplies as may be required.

On deck, on top of the cabin trunk, will be the observation room and observatories, consisting of a central observation room, 14 feet 8 inches in length and 16 feet in width, having on each end a circular observatory, 7 feet 8 inches in diameter, each fitted with a revolving dome constructed of bronze framework and plate glass.

The contract calls for the completion of the vessel on or before the first day of July, 1909. Her first voyage will be to the Hudson Bay and the North Atlantic, where very little information of the compass variation has been obtained. This survey will be of great service, because the Canadians, who are opening up the great wheat lands of Western Canada, expect to run a line of steamers through the Hudson Bay from Churchill to Liverpool, a route on which there is open water during the shipping months. After the completion of this work it is expected that the compass variations along the traversed routes on the Atlantic will be charted.

MARINE ENGINE DESIGN.

BY EDWARD M. BRAGG, S. B.

Calculations.—Make all valves piston valves. Assume eccentricity = 4¼ inches; lead upon top end = ⅝ inch for high-pressure and medium-pressure and ¾ inch for low-pressure.

As the design factor used in the first part of the calculations was 0.7, the following steam and exhaust speeds in feet per minute will be used:

Cylinder	High	Medium	Low
Entering steam.....	6,000	7,500	9,000
Exhaust steam.....	5,000	6,000	7,000

Speed of steam through throttle, 5,500 feet per minute.

Speed of steam in exhaust to condenser = 6,500 feet per minute.

The cut-offs obtained in the beginning were *H. P.* = 0.675, *M. P.* = 0.60, *L. P.* = 0.65. When the maximum port opening has been determined, the width of the port can be chosen to give these speeds. The means of the maximum port openings obtained from the diagram, of which only that for the high-pressure is shown (see Fig. 45), are as follows:

High-pressure, $\frac{2.12'' + 2.24''}{2} = 2.18$ inches.

Medium-pressure, $\frac{1.84'' + 1.96''}{2} = 1.9$ inches.

Low-pressure, $\frac{2.25'' + 2.39''}{2} = 2.32$ inches.

When the diagram for the low-pressure cylinder was drawn, it was found that very large valves would have to be used if the eccentricity was to be 4¼ inches, so the eccentricity for that cylinder was made 4¾ inches.

Width of port for high-pressure,

$$= 2.18'' \times \frac{6,000}{5,000} = 2.61'' \text{ (use } 2\tfrac{5}{8} \text{ inches).}$$

Width of port for medium-pressure,

$$= 1.9'' \times \frac{7,500}{6,000} = 2.375'' \text{ (use } 2\tfrac{3}{8} \text{ inches).}$$

Width of port for low-pressure,

$$= 2.32'' \times \frac{9,000}{7,000} = 2.98'' \text{ (use 3 inches).}$$

High-pressure piston valve,

$$= \frac{(23.5)^2 \times 850 \times 0.333}{5,000 \times 2.625} = 11.9'' \text{ (use 12 inches).}$$

Medium-pressure piston valve,

$$= \frac{(41)^2 \times 850 \times 0.333}{6,000 \times 2.375} = 33.5'' \text{ (use two of 17 inches).}$$

Low-pressure piston valve,

$$= \frac{(64)^2 \times 850 \times 0.333}{7,000 \times 3} = 55.2'' \text{ (use two of } 27\tfrac{1}{2} \text{ inchess).}$$

The port areas for cylinders and areas for exhaust steam through valves are:

Generated on 2024-09-12 07:29 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

High-pressure $= \pi \times 12'' \times 0.75 \times 2.625'' = 74$ square inches.
Medium-pressure $= \pi \times 34'' \times 0.75 \times 2.5'' = 200$ square inches.
Low-pressure $= \pi \times 55'' \times 0.75 \times 3'' = 389$ square inches.

Areas for entering steam are:

High-pressure, $74 \times \frac{2.18}{2.625} = 61.5$ square inches.

Medium-pressure, $200 \times \frac{2.02}{2.5} = 162$ square inches.

Low-pressure, $389 \times \frac{2.21}{2.875} = 299$ square inches.

Throttle valve and main steam pipe:

$$\frac{\pi(23.5)^2 \times 850}{4 \times 5{,}500} = 66 \text{ square inches. Use } 9\tfrac{1}{4}\text{-inch pipe.}$$

Pipe or pipes between high-pressure and medium-pressure valves:

$$\frac{74 + 162}{2} = 118 \text{ square inches. Use } 12\tfrac{1}{2}\text{-inch pipe.}$$

Pipe or pipes between medium-pressure and low-pressure valves:

$$\frac{200 + 299}{2} = 249.5 \text{ square inches. Use } 17\tfrac{3}{4}\text{-inch pipe.}$$

Pipe to condenser from low-pressure cylinder:

$$\frac{\pi(64)^2 \times 850}{4 \times 6{,}500} = 421 \text{ square inches. Use 23-inch pipe.}$$

The data for the valve gear should be collected, and given in some such form as shown in Table VIII. The words top and bottom at the heads of the columns refer to the steam upon the top side and upon the under side of the piston; the quantities given for release and compression are those resulting from the exhaust lap in the same column, the release occurring at one end of the cylinder and the compression at the other end.

TABLE VIII.

	High-Pressure.		Medium-Pressure.		Low-Pressure.	
Eccentricity	4½ inches		4½ inches		4½ inches	
Number and diameter of valves	1—12-inch		2—17-inch		2—27½-inch	
Steam Taken at	Middle.		Middle.		Ends.	
	Top.	Bottom.	Top.	Bottom.	Top.	Bottom.
Width of ports	2½″	2½″	2½″	2½″	3″	3″
Steam lap	2½″	2″	2 3/32″	2 9/32″	2½″	2½″
Exhaust lap	—¼″	+7/16″	+¼″	+13/16″	—1/16″	+⅛″
Angle of advance	40° 30′	.....	45° 30′	.....	42° 10′	.....
Steam lead, linear	⅛″	⅛″	⅛″	⅛″	11/16″	13/16″
Cutoff	0.715	0.635	0.64	0.56	0.69	0.61
Steam release before end of stroke	0.11	0.10	0.11	0.10	0.12	0.11
Steam compression before end of stroke	0.13	0.14	0.13	0.14	0.145	0.155
Maximum port opening	2½″	2½″	1 27/32″	1 31/32″	2½″	2½″
Maximum exhaust opening	2½″	2½″	2½″	2½″	3″	3″
Velocity of steam	6,180	5,820	7,750	7,250	9,250	8,750
Velocity of exhaust	5,000	5,000	6,000	6,000	7,000	7,000

The extreme diameters of the cylinder covers are as follows:

High-pressure, $23.5'' + 2 \times 1.125'' + 2 \times 0.75'' + 6 \times 1.25'' = 34.75''$
$34.75'' - 23.5'' = 11.25''$
Medium-pressure $41'' + 11.25'' = 52.25''$
Low-pressure, $64'' + 11.25'' = 75.25''$

The extreme diameters of valve chest covers are as follows: High-pressure piston valve = 12 inches inside diameter. Thickness of liner = 1 inch. The diameter of the hole under the cover = 12 inches + 2 × 1 inch + ½ inch = 14½ inches. Now, $185 \times (14.5)^2 \times 0.7854 = 30{,}500$ pounds. If 1-inch studs are used the pitch circle will be 14½ inches + 3 inches = 17½ inches diameter.

$\frac{30{,}500}{2{,}060} = 14.8$; use 16 studs. $\frac{17.5'' \times \pi}{16 \times 1''} = 3.44$ diameters apart.

Cylinder.	Valve Diameter.	Diameter of Stud.	Pitch Circle of Studs.	Number of Studs.	Spacing of Studs in Diameters.
H. P.	12″	1″	17½″	16	3.44
M. P.	17″	1″	22½″	17	4.15
L. P.	27½″	1″	33″	20	5.18

By Formula (51):

High-pressure valve chest cover
$= 12'' + 2 \times 1'' + 6\tfrac{1}{2}'' = 20\tfrac{1}{2}$ inches;
$20\tfrac{1}{2}'' - 12'' = 8\tfrac{1}{2}$ inches.

Medium-pressure valve chest cover
$= 17'' + 8\tfrac{1}{2}'' = 25\tfrac{1}{2}$ inches.

Low-pressure valve chest cover
$= 27\tfrac{1}{2}'' + 8\tfrac{1}{2}'' = 36$ inches.

The distance between the center lines of the medium-pressure valves, $= y$, should not be less than $1.6 \times 17.0'' + 1'' = 28.25$ inches, nor more than $1.8 \times 17.0 + 2.5 = 33$ inches. It was found best to use $y = 33$ inches, in order to keep the engine as short as possible.

X for the medium-pressure valves

$$= \sqrt{\left(\frac{52.25'' + 25\tfrac{1}{2}''}{2} + 1''\right)^2 - (16\tfrac{1}{2}'')^2} = 36.25'' \text{ nearly.}$$

For the low-pressure valves: $1.6 \times 27.5'' + 1'' = 45$ inches. $1.8 \times 27.5'' + 2.5'' = 52$ inches. Make $y = 45$ inches.

In order that the low-pressure valve cover may clear the covers of the medium-pressure valves by 1 inch, the distance between these valves and the center line of the low-pressure cylinder should be

$$\sqrt{\left(\frac{75.25'' + 25.5''}{2} + 1''\right)^2 - (16\tfrac{1}{2}'')^2} = 48\tfrac{1}{2} \text{ inches, approximately.}$$

The minimum distance between the low-pressure and medium-pressure cylinders will then be 36.25 inches + 48.5 inches = 84.75 inches.

Piston Valves.—Piston valves are made solid, as shown in Fig. 48, or hollow, as shown in Fig. 49. They are made hollow when it is desired to have one pipe supply steam to both ends of the valve, and the area through the middle of the valve should equal the area through the pipe. The length of the valve depends upon the location of the valve liners, which are placed a sufficient distance from the top and bottom of the valve chest to allow the steam to enter and get away from the ends without the area for steam passage being restricted. The liners should be placed as near the ends as possible, and the passageways to the cylinder made as direct as possible, in order to reduce the clearance space. The length of the liners should be such that the piston valve rings will not spring out at the extremities of the stroke. The liners should be counterbored at the ends sufficiently to allow the rings to over-travel ¼ inch or more. The length of the piston valve liner = width of port + steam lap + exhaust lap + the travel of the valve.

The valve stems, eccentric rods and links must be designed to take care of the frictional load, the inertia and the weight of the valves. In addition, if a single valve is used with a guide, such as shown in Fig. 50, the stem below the valve must be designed for the bending that may come upon it from the

Generated on 2024-09-12 07:38 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

pull of the drag rods in reversing when the valve is at its lowest point in the stroke.

In the case of the slide valve, the frictional load can be calculated from the area of the surfaces in contact and the unbalanced pressure upon the back of the valve, no allowance being made for any balancing device. The piston valve is not subjected to any load due to unbalanced pressure, but the friction of the rings and the stuffing-box must be allowed for. It is usual to assume that this load is some multiple of the weight of the valve, valve stem, cross-head and block. If this load is taken as three times the weight of the above parts, a reasonable allowance will be made.

The inertia of the valves is calculated upon the assumption of harmonic motion, and the maximum inertia, at the beginning and end of the stroke, is used. The formula which gives this inertia is:

$$F = 0.00002837WRN^2, \quad (52)$$

where W = weight of valve or valves, valve stem, crosshead and block, usually for the low-pressure gear;
R = length of crank, or eccentricity in inches;
and N = revolutions per minute.

In the case of piston valves, the load for which the valve stem should be figured will be:

$$L = W(4 + 0.00002837RN^2), \quad (53)$$

if no balance piston is used; and

$$L = W(3 + 0.00002837RN^2), \quad (54)$$

if a balance piston is used.

If balance pistons are used which balance more than the weight the load can be still further decreased.

In the case of slide valves the load upon the valve stems will be:

$$L = pAf + W(1 + 0.00002837RN^2), \quad (55)$$

if no balance piston is used; and

$$L = pAf + 0.00002837WRN^2), \quad (56)$$

if a balance piston is used;

where p = the unbalanced unit pressure upon valve;
A = area exposed to unbalanced pressure;
f = coefficient of friction, usually taken as 0.2;
and W, R and N are as above.

The portion of the valve stem between the valve and the link block in the case of single valves, and between the piston valve and the yoke in the case of twin valves should be figured by means of the piston rod formula; the portion of the stem within the valve should be figured for tension only, as the stem is shouldered down where it enters the valve, and the thrust is carried by this shoulder.

This load L is carried by the links, and when they are at an angle with the horizontal (see Fig. 51) there will be a tendency for the block to slide along the links. As the valve stem is kept from moving by the valve stem guide, this tendency results in a bending moment upon the valve stem, and a reaction in the drag rods to keep the links from moving. The maximum angle that the links make with the horizontal is assumed to be:

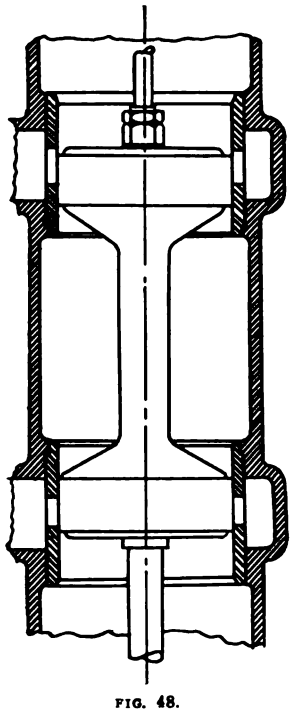


FIG. 48.

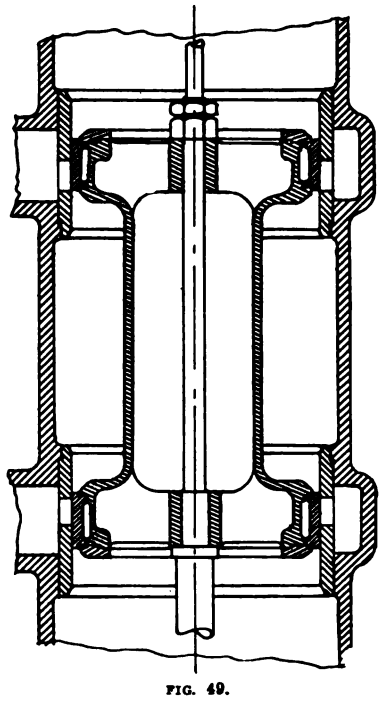


FIG. 49.

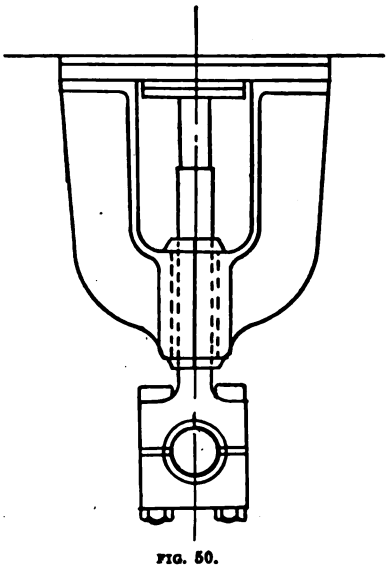


FIG. 50.

$$\sin^{-1} = \frac{2E \sin (90 - d)}{b}, \quad (57)$$

where E = eccentricity of valve;
d = angle of advance;
and b = distance between eccentric rod pinsually = $6E$.

This formula, upon the assumption of $b = 6E$, becomes

$$\sin^{-1} = \frac{\sin (90^\circ - d)}{3}. \quad (58)$$

The component bending the valve stem will be

$$P = \frac{L \sin (90^\circ - d)}{3}, \quad (59)$$

and the bending moment upon the valve stem will be $M = Pl$, where l is the distance from the bottom of the valve stem guide to the lowest point in the travel of the link block. For twin valves, with the stems yoked together, the bending moment would act upon the yoke, which always has plenty of strength.

If the eccentric rod were normal to the link at the time when the latter makes its maximum angle with the horizontal (see Fig. 51) the load P would be all that the drag rods would have to carry; but since the eccentric rod is in line with the valve stem at that time, a portion of the load normal to the links will come upon the drag rods, in addition to the component along the links. In the diagram accompanying Fig. 51,

Generated on 2024-09-12 07:32 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

AO is the load *L* acting through the valve stem. This load is resolved into *BO* along the links and *AB* normal to the links. Since the eccentric rod is in the position *OD*, the load *OC* = *AB*, normal to the links, is resolved into *CD* and *OD*. The

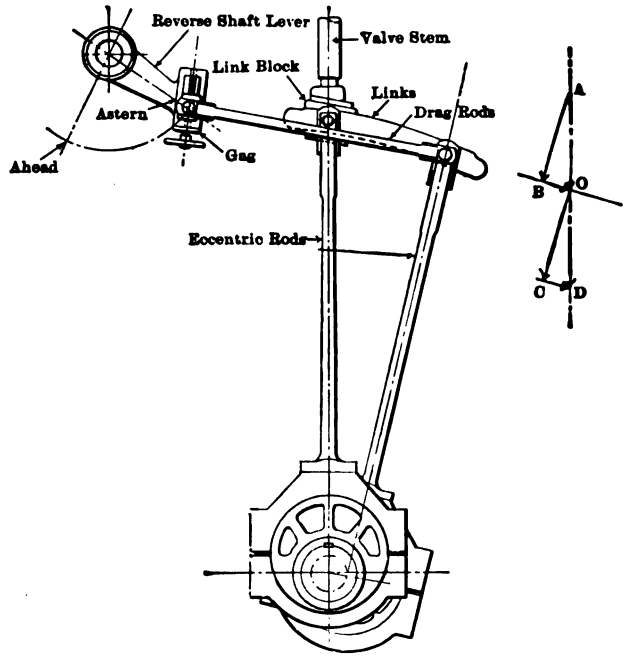


FIG. 51.

drag rods have to take care of $BO + CD = 2P$, and the eccentric rod is subjected to the load *L*. Although the drag rods are not exactly parallel to the links in the position shown, the load upon the rods will be practically $2P$, so that each rod should be designed for the load *P*.

(To be Concluded.)

THE HEATING OF MODERN OCEAN LINERS.*

BY W. CARLILE WALLACE.

When we consider that the modern ocean liner has developed into a vast floating hotel, carrying many thousand souls, the importance, from a sanitary standpoint, of effectually ventilating every part of the vessel, and maintaining the passenger accommodation at an equitable temperature, can hardly be over-rated. For vessels of even moderate size, the necessity of some form of mechanical ventilation has proved to be a necessity, as only by that means is it possible to insure a rapid change of air throughout the passenger and crew accommodation, in all kinds of weather.

On the modern ocean liner, the higher-priced state rooms and suites are occupied much more during the day than was the case when the state rooms were only 6 by 7-foot boxes, with two or four berths in them, as the case might be. Passengers are becoming more difficult to please, and competition is becoming keener, so that a shipping company wishing to retain its patrons must equip its vessels with all the luxuries of a modern hotel. As maintaining the individual rooms at an equitable temperature is not the least important of these, I propose, therefore, to restrict the scope of this paper more especially to this problem.

Among the first ocean steamship companies to give the question of ventilation and heating the attention it deserves, the American Line is well to the front, as the *St. Louis* and *St. Paul*, built in 1895, were equipped with a very complete system, consisting of a number of pressure fans, placed on the boat deck, forcing air by means of suitable ducts into the principal state rooms, public rooms and alleyways, the air being warmed by passing over steam-heated coils, suitably arranged close to the fan discharge. Suction fans are also provided and connected to another set of ducts for drawing away the vitiated air from the different rooms. The system has worked fairly satisfactorily as far as the ventilation is concerned, but it has been found impossible to regulate the heat in the state rooms with any degree of certainty.

Leading a double set of ducts throughout the vessel is expensive in first cost, and as space is naturally restricted, the ducts must be kept small; this necessitates an increased velocity of air in the ducts, so as to get a sufficiently rapid change of air in the rooms. As the power to drive these fans increases as the square of the velocity, it becomes apparent that this, together with the increased skin friction consequent on the higher speed of the air, very greatly increases the cost of operation.

A very similar system of ventilation is fitted in the newer vessels of the Red Star Line, the warm air being discharged in these vessels into the public rooms and alleyways on the different decks; and exhaust fans for the removal of the vitiated air being fitted, having ducts leading from the state rooms, these latter being dependent for heat on the warm air from the alleyways being drawn in through venetian panels in the doors to supply the place of the vitiated air drawn out by the exhaust fans. In cold weather, it is found that this system is inadequate to warm the outside rooms, even when the temperature in the alleyways and other parts of the ship is high and the inside rooms much too warm. In summer, with a high outside temperature, this system is worse than useless as a means of cooling the vessel, as observation has shown that the air discharged into the alleyways, etc., by the pressure fans is for several easily-explained reasons from 5 to 10 degrees Fahrenheit above the temperature of the outside air, and as the exhaust fans alone are not of sufficient capacity to ventilate the vessel, there is no alternative in warm weather between having the vessel uncomfortably hot through forcing in fresh heated air, or stuffy and ill ventilated through depending entirely on the exhaust system for ventilation.

To get over these difficulties, numbers of other schemes have been tried, as, for instance, making the ventilation and heating systems more or less independent of each other, the heat in these cases being supplied by individual steam or electric heaters placed in each state room, and more or less under the control of the passengers themselves; the ventilation being affected by exhausting the vitiated air from the rooms and alleyways, the fans and ducts being of sufficient capacity for this purpose, and fresh air entering by storm-proof ventilators, doors or other openings in the passenger accommodation. This system has the advantage of enabling the heat to be regulated without affecting the ventilation in the state rooms, the temperature there being adjusted to suit the varied ideas of the occupants. That this is a matter of no small importance will be vouched for by any chief engineer in the Atlantic service, for should he be so unfortunate as to have an American and an Englishman in state rooms supplied from the same warm-air ducts, he will have a condition of matters which will give him considerably more worry during the voyage than will the main engines.

There are so many manifest objections to placing steam heaters in all the rooms that it is hardly necessary to enumerate them. They are apt to cause an unpleasant smell when first turned on; the multiplication of valves and pipes is a very serious evil, to say nothing of the risk of some of the heaters freezing and bursting while the vessel is lying in port in winter on the American side. On the other hand, electricity lends itself admirably to individual heating at very small initial expense, as every state room is wired for light-

* From a paper presented before the Institution of Naval Architects.

Generated on 2024-09-12 07:28 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

ing, and it only becomes necessary to increase the size of the wires to provide for the extra current.

With the idea of meeting the difficulties already enumerated, and dispensing, if possible, with the individual heating, there has been installed on board the *Lusitania* and the *Mauretania* an elaborate system of heating and ventilation. All this work was carried out by the Thermo-Tank Ventilating Company, Glasgow, and is, I think, without doubt, the best and most thorough scheme so far supplied to any vessel. One special feature which, in the opinion of the writer, will be found of great advantage in warm weather, is the possibility of being able to reverse the direction of the air currents in the ducts, the fans under these conditions exhausting the foul air from the rooms in large quantities, thus causing fresh air to be drawn in through open side-lights, doors, windows, ventilators and other available points.

With regard to the practical working of the system, I believe it has given excellent results as far as the heating and ventilation of the third-class accommodations are concerned, also in the large public rooms, and public open spaces in the passenger accommodation. Unfortunately, from structural and other reasons, it has been found impossible to avoid supplying inside and outside state rooms with warm air from the same thermotank; on that account, I fail to see how it is possible to supply a sufficient quantity of fresh air at the same temperature to insure proper ventilation to both these classes of rooms, at the same time keeping them at the same temperature.

It is only necessary to glance at the plan of the engine and boiler spaces of these vessels to appreciate the enormous the hull. The major portion of the heat, no doubt, escapes by means of the funnel, hatches and engine room and stokeamount of heat which must be radiated from surfaces inside hold upcast ventilators, but still a larger amount must be conducted through the decks, bulkheads, casings, etc., tending to warm up the interior of the vessel.

For this reason there must be many inside rooms, even as high up as the promenade deck, which will require but a very small amount of additional heat to make them comfortable even in the coldest weather; whereas for the outside rooms on the same deck, with one side, and in some cases two sides, exposed to the weather, a large amount of heat will be required. That this internal heat, so to speak, exists in a vessel, is borne out by observations under all conditions of weather, conducted by Doctor Geissinger, surgeon of the steamship *St. Paul*, from which he found that unoccupied state rooms, depending on their position on the vessel for heat, maintained a certain definite temperature above the outside air during the voyage.

From a careful analysis of the different systems of heating, the conclusion is obvious that the one best adapted to large passenger steamers is a combination of a system similar to that fitted on board the *Lusitania* and *Mauretania*, supplemented by a system of individual electrical heating, the whole combination being under automatic control. Until very recently, there has been no reliable automatic device for regulating the temperature of a room warmed by an electric heater. Numbers of electrical thermostats have been patented, but they have all failed under the test of practical application, and whatever possible success they may have attained on land, they were absolutely useless on board a steamship, owing to their sensitiveness to the slightest vibration.

Some years ago the attention of Dr. Geissinger was drawn to the necessity of some means of regulating the temperature in his room on board the *St. Paul*, which was supplied with an electric heater; as he found that if he left the heater on while absent, the room became much too hot in moderate weather; whereas, if turned off, the room became too cold. Any attempt to use existing thermostats was an utter failure, as he at once found that, owing to vibration, the switch controlling the heater would be destroyed in a few hours, and the contact points of the thermostat itself ruined through oxidization. As a final result of his investigations, he has succeeded in constructing and patenting an electrical thermostat which is positive in its action, controls the temperature within one degree Fahrenheit, is absolutely unaffected by vibration, and requires only 2.75 watts for the controlling current.

For use in staterooms, hotel rooms, etc., the instrument is a combination of two thermostats in one case, the one set for the day temperature of, say, 69 degrees Fahrenheit, the other for a night temperature of, say, 64 degrees Fahrenheit, or less, if desired, both temperatures being easily adjustable to suit the requirements of the occupant of the room. The use of a lower night temperature is very desirable from a health point of view, but has also an important bearing on the quantity of current necessary to maintain this lower temperature, as will be seen later. To change from one temperature to another it is necessary only to throw over an electric switch, when the thermostat takes care of the rest. This thermostat has now been in use in the state room of Dr. Geissinger for over two years, with perfect success.

That there is a very important saving in the amount of heating current when properly regulated, and that, in such cases, the cost of electrical heating is moderate, is well shown by the following report of a deduction from a series of observations taken during the east-bound and west-bound trips of the *St. Paul* between Nov. 23 and Dec. 15, 1907.

The surgeon's cabin is an outside room situated on the first covered deck, and is 7 feet 6 inches by 8 feet, and 7 feet 6 inches high. The ceiling of the room is composed of the bare plating and beams of an exposed deck. The outside paneling is entirely uncovered between two frames and, therefore, this area is practically exposed to radiation through the steel hull to the external air. The cabin is provided with a liberal supply of fresh air through a duct and 4 by 4-inch uptake, and the door is arranged with the customary louvre panel. The ventilation, therefore, is quite up to the standard, and, for certain reasons, the incoming air is rarely or slightly heated. For this particular room, the demand on the heat supply is, therefore, certainly as heavy as that of the ordinary promenade deck state rooms. The room is warmed by one of the regular electric heaters manufactured by the Consolidated Car Heating Company of New York, which consumes 8 amperes at a pressure of 110 volts.

For the purpose of observation, the days were divided into periods, viz.: 8 A. M. to 11 P. M. and 11 P. M. to 8 A. M., which in the following data are referred to, respectively, as "Day" and "Night."

During the day the temperature was kept at 69 degrees Fahrenheit and at night at 64 degrees Fahrenheit, by means of a Geissinger electro-thermostat. This was arranged to operate on a switch which controlled the amount of current supplied to the electric heater aforementioned. In the circuit between the switch and the heater was placed a wattmeter, which recorded accurately the amount of current consumed by the heater in keeping the room at the desired temperature. Careful records were taken of the wattmeter readings, as well as the external temperature and that of the incoming air, for both day and night periods. Summing up the observations taken, the following results were obtained:

SUMMARY OF OBSERVATIONS

Voyage No. 151 East, S. S. St. Paul

	Day.	Night.
Average external temperature..	47.1°	44.8°
Average temperature of incoming air (ventilation)....	64.3°	64.4°
Actual consumption by wattmeter	31.9 KW.hr.	4.8 KW. hr.

Generated on 2024-09-12 07:33 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Extra electric energy (consumed by lamps and for resistance)	9.0 KW. hr.	3.4 KW. hr.
Net consumption	40.9 KW. hr.	8.2 KW. hr.
Total for trip		49.1 KW. hr.

Voyage No. 152 West, S. S. St. Paul.

	Day.	Night.
Average external temperature	45.5°	44.7°
Average temperature of incoming air (ventilation)	64.6°	64.8°
Average temperature of room	69.°	64.9°
Actual consumption by watt-meter	50.6 KW. hr.	7.1 KW. hr.
Extra electric energy in room (consumed by lamps and resistance)	9.5 KW. hr.	2.5 KW. hr.
Net consumption	60.1 KW. hr.	9.6 KW. hr.
Total for trip		69.7 KW. hr.

In reference to the remarkable difference in power used in the day and night periods, it should be stated that the consumption for the night is so much smaller than that of the day, because the actual time of observation is much shorter and also because the amount of heat required to raise the warmth of the room from the night temperature to the day temperature is comparatively large, and naturally it appears in the total reading for the day.

The following observations conducted recently on board the steamship *Oceanic* should be of interest to naval architects, showing, as they do, the average expenditure of electric energy of a typical and purely electrical system of heating where the passenger has complete control of the heaters.

The halls and public rooms of the vessel are heated by means of steam coils, whereas the staterooms on the two upper decks are heated by electric heaters, consuming on an average 1,200 watts per hour each. These rooms, being on the promenade decks, are ventilated by means of ducts, one to each room, having the intake close under the deck in the center of the outside alleyways or promenade, leading from thence into the side of the deck house, down the side of the stateroom behind the casing, and opening to the room through a ported slide just behind the electric heater, which is placed under the sofa. The doors are solid panels, movable louvres being fitted at the top of the room between the beams, and leading into the hallways.

An accurate record was kept of the consumption of current used in heating the staterooms of this vessel during one round voyage.

It is worthy of note here that, though this ship was originally fitted with multiple-circuit heaters and switches, giving medium, low and maximum heat, it was found advisable to substitute simple heaters of maximum capacity; the finer-sized wires of a divided circuit heater frequently burning out and giving trouble. It was also found that the average passenger did not possess sufficient mechanical knowledge to master the graduation of the switch, and was disposed to blame any extremes of temperature on this mechanism.

Anyone who has had sea experience will appreciate the foregoing observation of the mental apathy of passengers of all classes, for if a passenger is to be made comfortable it must be accomplished without effort on his part, and by far the greater number of complaints regarding the heating and ventilating are usually due to the passenger's neglect or inability to help himself to the means of regulation provided in any properly-installed system.

As a means of determining the actual amount of current necessary to maintain a given temperature in the rooms of the *Oceanic* a test was made on Jan. 28, 1908, while the vessel was lying in dock in Southampton, upon a representative room on the shelter deck. This room is 9 by 9 feet by 8 feet 3 inches, with two square ports and one exposed side, the ventilator and heater being as already described. The heater was tested and found to consume 1,045 watts. The external temperatures were 44½ degrees at the beginning and 42 at the end of the test. The room, which had been closed for three days, was found to be at a temperature of 57½ degrees, and by deduction the effect of the internal heat (I) was estimated to be 10 degrees (that is, the room would have been the standard temperature of 70 degrees if the external temperature had been 60 degrees). The heater was run full power until the temperature reached 69½ degrees, when, after several tests, it was found that if the heater was on for a period of two minutes and off three minutes, the temperature remained constant at 69½ degrees. The radiation, expressed in terms of electrical energy, was therefore determined to be 418 watts per hour, when the external temperature was 42 degrees and the internal heat, as already stated, 10, and, for this special room, may be expressed by the equation $W = 24\ (R\text{-}E\text{-}I)$; when W equals watts per hour, R, temperature at which room is to be maintained; E, external temperature, and I, internal heat. It was also found that 520 watts were required to raise the temperature of the room from 64 degrees, the night temperature, to 69 degrees, the day temperature, in addition to the amount radiated.

A curve of theoretical consumption of energy based on the foregoing formula was plotted for the *Oceanic*, with an assumed temperature for rooms of 69 degrees during the day and 64 degrees at night. In view of the large difference between the theoretical and observed consumption of energy, it may be well to consider in what way the conditions at sea may modify the observations of heat dissipation taken in port.

The ventilation of the room, depending as it does on the force and direction of the wind, is no doubt greater at sea than in port, but assuming that an extra amount of air entering the room was 10 cubic feet per minute, the consumption factor would be increased by 4 $(R\text{-}E)$, or from 24 to 28, or about 16 percent. On the other hand, the internal heat (I) would be naturally larger with the boilers in full operation. On the steamship *St. Paul*, I has the value of 8 and 12 in port and at sea, respectively. This correction if applied to the *Oceanic* would increase I from 10 to 15 and decrease W' by 120, or about 28 percent. The adjoining rooms and hallways would also be at a higher temperature, therefore it seems safe to assume that the estimation of electric energy in port is in excess of the sea requirements.

The records of actual consumption were obtained by running the heaters of the stateroom from one machine the entire voyage and reading the ammeter every two hours; the external temperatures were also taken every two hours.

The steamship *St. Paul*, sailing from both ports three days later, encountered different temperatures, and the consumption as recorded for comparison is correct for these differences, the equation for this vessel being $W = 20\ (R\text{-}E\text{-}I)$ for radiation, and $W' = 20\ (R\text{-}A)$ for ventilation, where $I = 12$, and A is the temperature of the incoming air.

In presenting these records, the consumption has been divided by the number of rooms occupied on the trip by passengers. It is obvious that at no time were all the heaters in use, due to the wish of some of the occupants for cold air, and that the reduction to an average of one room is rather unfair to a comparison of a definitely-heated room, however valuable to the engineer as an average daily record of power used.

These records of the *Oceanic* are especially interesting in that they show the consumption of energy in two extreme con-

Generated on 2024-09-12 07:36 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

ditions. On the westbound voyage this ship passed through exceptionally cold weather, as evidenced by the average temperatures 37.6 and 35.8 day and night, whereas in the eastbound passage the average temperatures were 53 and 52.4, temperatures more in keeping with the month of May.

In this connection it is surprising to find such small differences in the consumption of power between the two voyages, proving the statement already made that the average passenger does not use his heater with reason, or even cater to his own comfort in the smallest degree. It will be noticed that the corrected consumption of the steamship *St. Paul* comes into very close agreement with that calculated for the *Oceanic,* and verifies most strongly the basis on which the latter calculations were made.

On the charts of the steamship *St. Paul* the top lines show the temperatures of the room, ventilating air and external air. The room temperatures are shown for convenience as sharply-broken lines, though the change from high to low and the reverse necessarily takes some time. The other temperatures are recorded in curves joining the average for the period and do not show the hourly variations that are actually found in the ventilating air when steam is turned on.

Taking the cost of coal at 1.2 cents (0.6d.) per kilowatt-hour, which is certainly a low estimate, and applying it to the estimated waste of electrical energy, in the case of the *Oceanic* we get for the westbound voyage a loss of $34 and for the eastbound of $52, or on the round voyage, say, $86 (£17-13-5) in heating forty-nine staterooms. For seven round voyages per year, during which heat is certainly advisable, we get a total loss of £123-14-0 ($602) per annum, which might be saved by placing the heaters under automatic control, so that, regardless altogether of the luxury of definite temperatures, the subject becomes a matter of some financial importance.

	West		East	
	"Day."	"Night."	"Day."	"Night."
Oceanic, observed*	812	844	672	644
Oceanic, calculated*	555	375	174	49
St. Paul, corrected* (for comparison only)	536	296	191	...
Apparent waste*	257	469	498	595
Seven days' waste†.....	27	31.9	52.2	34.5

	West.	East.
Seven days' waste total†.....	58.9	86.7
Number rooms occupied.....	48	50
Total waste for ship†.....	2,827	4,340
Cost at 1.2 cents per unit.....	$34	$52

Cost of waste for one round voyage, $86 (£17-13-5).

* Watt-hours. † Kilowatt-hours.

THE AUTOMOBILE TORPEDO OF TO-DAY.

BY A. M. HOFFMANN.

The general public has but a very imperfect idea of the advance that has been made in the development of the automobile torpedo within the last few years. For a great many years after Whitehead built the first of these instruments of destruction, they were notoriously unreliable, despite all of the skill and cunning with which they were fabricated. The principal trouble lay in keeping the torpedo on a straight path. Its powers of inflicting damage when it did hit were undeniable, but there was a large margin of painful doubt before the torpedo finished its run; it was just as apt to hit the ship discharging it as it was likely to hit the target toward which it was started. Only a very few years ago, the same sized torpedo was issued generally to all vessels without regard to the different fields of service for those craft; and the largest of the torpedoes was not more than 3.55 metres (13.98 feet) long. To-day, however, the torpedo has grown to a length of fully 5 metres (19.69 feet), and a distinction is made in assigning these weapons to vessels; torpedo boats being fitted with 18-inch torpedoes of very high speed but shorter range, while the heavy-armored ships carry torpedoes of 21 inches diameter of greater effective range but lower speed. This is instructive, inasmuch as it shows an outcropping of the eternal tendency to specialize, class distinctions thus developing even between torpedoes; and it has been suggested that before long we shall see a further differentiation in the form of a particular style of torpedo to be carried

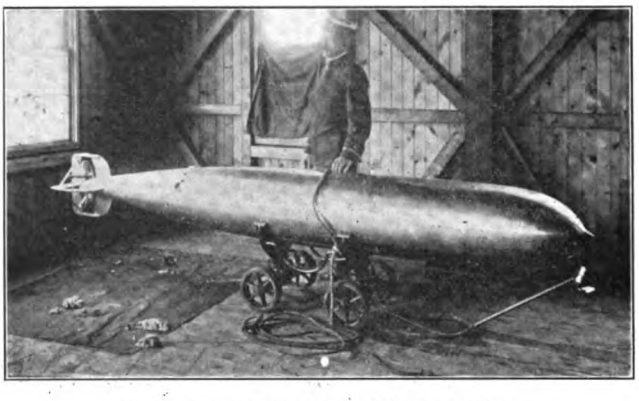


FIG. 1.—THE LATEST TYPE OF 18-INCH TORPEDO.

by submarine boats. In fact, it is believed by some naval experts that the submarine boat will soon prove to be the only practicable craft from which the best of the automobile torpedoes can be fired in order to secure the fullest advantages of the great speed and range now attained by these weapons.

The motive power of the modern torpedo is compressed air. Ten years ago the air flasks of the largest torpedoes were charged to a pressure of 1,350 pounds to the square inch, while to-day the working pressure for the latest types is 2,250 pounds to the square inch; and there is reason to believe that we shall have a further increase as metallurgical advances make it possible to fabricate air flasks of moderate weight which shall be capable of safely withstanding the stress of higher pressures. Pent-up energy of this sort makes the air flask, by itself, a weapon of no mean potentiality. Three years ago, the French battleship *Jaureguiberry* was struck by a torpedo during peace-time practice, and the air flask exploded with sufficient force to crack one of the big propeller struts and cause such leakage around the stern—by reason of damaged plating—as to compel the docking of the ship and incidental repairs, which consumed some weeks. This is significant of the power stored up within these weapons for their self-propulsion.

Until within the past year or two, the range and speed of the torpedo were limited by the initial capacity of the air flask; and the pressure in the flask began to lessen, of course, from the first moment air was permitted to pass to the driving engines, and it did not seem possible to mend matters in that direction. At this point, however, American ingenuity came to the front and devised a means of increasing the motive capacity of the initial air supply by causing its expansion through heat skillfully applied. This was a courageous undertaking, because, at first blush, there seemed a dangerous menace in the possibility of overheating the air and bursting the flask. However, mechanical cunning overcame this obstacle by causing the pressure in the air flask to automatically regulate the flame which superheated the compressed air, and in this manner the developing pressures were made to balance and control themselves. As a result of this pioneer

Generated on 2024-09-12 07:33 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

work, the first 21-inch torpedoes attained very remarkable results; in fact, the speed was increased nearly 50 percent, while the effective endurance or range at the old speed was more than doubled. Since then, correspondingly good results have been secured with the 18-inch torpedo, and the following table will show directly what the superheater has done:

RANGES OF 18-INCH TORPEDO UNDER BOTH CONDITIONS.*

	Air Unheated. Knots.	Air Heated. Knots.
At 1,000 yards	35	43
At 1,500 yards	30	40
At 2,000 yards	28¼	38
At 3,000 yards	23 to 24	32
At 4,000 yards	18 to 20	28

It may be of interest to know in a general way how this is accomplished. In addition to the air flask charged with the motive force for the torpedo, there are two or three small

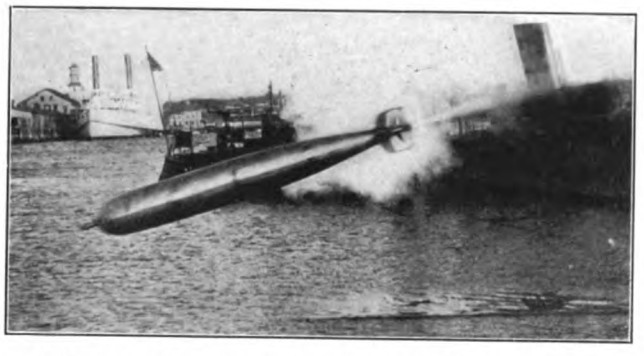


FIG. 2.—DISCHARGE OF A TORPEDO FROM THE DECK OF A TORPEDO BOAT.

flasks which are filled with alcohol and yet retain a little space for a reserve of air. These flasks or tanks are connected to a burner in the big flask or air chamber. When the torpedo is discharged from the torpedo tube the pressure used to expel the weapon—either air or powder—is sufficient to open a little valve which turns on the air to the engines and at the same time opens a connection between the air chamber and the flasks containing alcohol. After the engines have been running a few moments there is a difference between the pressure in the fuel flasks and the pressure in the motive air chamber—the latter being lower. As a result, liquid fuel is forced into the burner in the air chamber and at the same time a cunningly-devised trigger is released which explodes a fuse and ignites the alcohol. Immediately, the heat thus generated causes the air in the chamber to expand and incidentally the working pressure is raised. This pressure, after reaching a point above that in the fuel flasks, restrains the flow of the alcohol automatically until the chamber pressure is again lower than that of the air in the fuel system, the pressure of which is reflexively maintained by the surplus power developed in the main air flask. This added gain in motive force by the use of heat would be of little avail if it were not for the "reducing valve," which stands guard between the air chamber and the engines, permitting air at a uniform speed and a reduced pressure only to be fed to the motive mechanism, in this manner preventing the sudden expulsion of the air and the probable destruction of the engines by reason of the wracking vibrations of too high a rate of revolution. This reducing valve is one of the cleverest features of the modern torpedo, and is automatic.

The Whitehead torpedo, which has followed the American, or Bliss-Leavitt torpedo, in the adaptation of a superheater, works in a different way, the superheater being placed outside of the air chamber and between the "reducing valve" and the motor. As a result, the reducing valve likewise controls the pressure produced by combustion and automatically both the air and the fuel supply, so that it is able to maintain a constant temperature irrespective of the quantity of air or fuel used. The secondary advantage of this arrangement lies in the fact that the air exhausted by the engines is warm and the risk of the formation of ice or frost in the moving parts is eliminated. Under the old condition, where the air was not superheated, the expansion at the exhaust valves was so great that it not infrequently reduced the temperature sometimes to several degrees below zero. This not only produced frosting, but it congealed the lubricant and seriously handicapped the working efficiency of the machinery. In addition to this, the cold water of winter in northern climates helped to this end—it is impossible to run the ordinary cold-air torpedo when the temperature of the water falls to the neighborhood of 40 degrees Fahrenheit, because of the effect upon the initial pressure in the air chamber, and the superheater has thus removed one of the obstacles to effective service in winter time.

Until recently, torpedoes were driven by a wonderfully-compact little engine of the ordinary cylinder or reciprocating order known as the "Brotherhood" balanced type. Although small enough to be housed within a good-sized cheese box, these engines have been able to develop something over 60 horsepower, but the turbine has now supplanted them and added greatly to the speed and to the range of the torpedo by taking up less room. The gain in range has been due to the fact that the motive air is used more economically, while the increase in speed followed because of the fewer moving parts and the incidental reducing of friction.

Until the last few years, the gyroscope installed in torpedoes was spun by a spring which was generally wound a short while before the torpedo was launched. Apart from the shock due to this sudden impulse and the fact that there was thus a limit to the delicacy with which the instrument could be constructed, the gyroscope received no further impulse during the run of the torpedo; as a result there was a gradual lessening of the effective corrective force exerted by the gyroscope or Obry gear, as it was then called. With the introduction of a turbine-driven gyroscope operated by an air impulse, not only was the initial shock due to the spring release done away with—permitting a more finely-balanced device—but the gyroscope was kept in continuous motion by a constant air impulse. The increased smoothness of running due to this modified gyroscope has greatly flattened the path of the torpedo, so that it now travels on a straight line in-

* The latest development of the 21-inch torpedo is said to have a range of 7,000 yards.

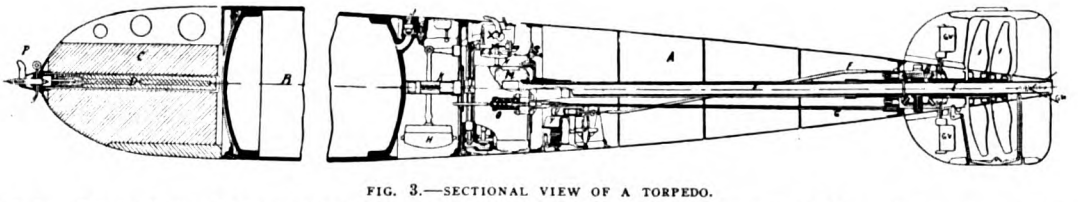


FIG. 3.—SECTIONAL VIEW OF A TORPEDO.

A, After Body. *B*, Air Flask. *C*, Gunpowder Charge. *J*, Air Valve. *M*, Turbine. *N*, Reducing Valve. *V*, Gyroscope. *X*, Superheater.

Generated on 2024-09-12 07:39 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

stead of the very sinuous one of old. This naturally increases the range and the linear speed of the weapon. The balanced turbine for this work is the invention of an American naval officer, and it is a wonderfully cunning piece of mechanism.

The gyroscope is so arranged that it controls the movement of a little motor which, itself, is of sufficient power to move the rudders guiding the torpedo in a horizontal direction. Before the Obry gear was invented, the torpedo was a very uncertain weapon. Dents or other imperfections in the surface of the torpedo used to cause it to steer badly; and if the vessel were moving at the time the torpedo was discharged, and the torpedo struck the water improperly, it was easily "tumbled" and deflected from its desired target. Especially was this so if the torpedo rolled on entering the water so as to cause its horizontal rudders—which normally control depth—to become, pro tem, vertical or lateral rudders. The Obry gear reduced errors due to these causes to a marked extent, but the improved turbine-driven gyroscope of to-day has, in its turn, greatly increased these powers of directive correction.

The gyroscope has been still further widened in its usefulness by making it adjustable, so that the original purpose of holding the torpedo to its line of discharge has been amplified in a manner that now makes it possible to expel the torpedo at an angle of quite 120 degrees from its intended target and yet have the gyroscope bring the torpedo gradually round through that arc and then turn it and hold it in a straight line for its objective. The advantages accruing from this permit of the simultaneous discharge of a torpedo boat's full complement of tubes even though they can not be made to point forward or to bear directly upon the target. All the commander has to do is to adjust the gyroscopes to their proper angles in advance and to point the tubes so that after the torpedoes have described the arcs of these angles they will then point parallel to the fore-and-aft center line of the boat or the direction in which the craft is pointed at the time of their launching. This permits the torpedo boat to approach her target head-on, and thus to offer her most moderate area for the attack of an enemy's gun-fire. When within striking distance, all of the tubes can be discharged simultaneously and with excellent chances of hitting the mark and doing effective work.

It was only a very few years ago that $2,500 would cover the cost of a torpedo; to-day, the prices range all the way from $5,000 to $7,100 apiece. The cost of these torpedoes made the Navy Department reluctant to risk many of these weapons in target practice until the coming of the "soft-nosed" or collapsible-headed torpedo. Torpedoes now fitted with these practice heads can be safely fired against a ship without damaging the vessel or risking the loss of the torpedo, and officers and men are now given the training absolutely needful in order to make them of value in time of war.

The United States naval programme for 1909, as outlined in the Naval Appropriation bill recently reported by the House committee on naval affairs, provides for fifteen new vessels, to cost approximately $29,000,000 (£5,959,000). The bill provides for two 26,000-ton battleships, five torpedo boat destroyers, four submarine boats, one sub-surface torpedo boat and three colliers. The two battleships will be the largest ever laid down by several thousand tons, as their displacement will be 26,000 tons, and it is understood that they will carry twelve 12-inch 50-caliber guns in six turrets, all placed on the center line of the ship. Additional expenditures will bring the total naval appropriation for the year up to $132,000,000 (£27,140,000), as compared with $123,000,000 (£25,290,000) of the current fiscal year.

PIPING UP A MERCHANT VESSEL FOR STEAM HEAT.

BY ALLAN DALE.

Almost the last work of importance to be started in a shipyard drafting room, and the first to go aboard the vessel after it is launched, is the steam-heating system; and the draftsman who handles this work, unless he is an "old timer" and "right on the job," is on pins and needles while it lasts, for it is one continuous case of rush, with little or no time to think.

The reasons for this are as follows: First, it is quite impossible for the draftsman to locate his coils or radiators until the deck or "joiner plans" are completed and approved and the principal rooms detailed; as otherwise the heaters may foul a berth, a desk, the drawers under the berth, the door of a shoe locker, or numerous other things. In fact, the spare room left by the furniture may be so little that no commercial-size radiator can be bought to fit the space, and the furniture will have to be shifted or an especial shape coil be made to fit. Hence, the reason for starting this plan last of all.

Second, it is equally important that the pipe fitters get all their work in place before the polished furniture is installed and before the painters put on the final coat; in fact, before the woodwork is painted at all, as otherwise the scratched or marred surfaces (ruined by the installation of the work) will require refinishing and retouching, which in turn causes needless delay and expense.

Thus it will be seen that once the plans can be started, the work should not only be carried on with the greatest possible speed, but should be so handled that no time is lost anywhere, and that the work in the yard and shop (such as getting out the material and making up the coils) may proceed even while the plans are being submitted for their final approval. To do this certain data should be at hand and a well-mapped routine followed to avoid the many little slips that tie up here and there and cause delay. The information given below, which embodies all this data, is based on years of experience and hard knocks, and no one is apt to go wrong by following it.

STARTING THE PLAN.

The first thing is to procure a plan of the decks—the joiner or arrangement plan—and figure out the square feet of space in each room to be heated, making no allowance for the furniture or lockers that may be in the room. Mark the totals in each corresponding room on the plan as you go along. This done, get the height, deck to deck, and multiply the square feet of each room by this height, marking the total cubic feet in each room underneath the square feet. One height will generally do for all the rooms on one deck. The height may vary, but unless the room be very, very large, this variation will be so slight that it does not affect the size of the heater.

This method will do away with the labor of making out a table or schedule of sizes of rooms, as you have the figures for each room before you, on the plan, in the corresponding room. It also eliminates all chances of error; as you will quickly, by glancing over your plan, detect any figures that may seem out of proportion to the size of room. You are now ready to make up your list of ratios.

RATIOS.

By ratio we mean the proportion of square feet of heating surface in the radiators or coils to the cubic feet of space in each individual room. These ratios vary greatly in different parts of the ship. It should be stipulated very clearly in the specifications what ratios are to be used. Where this is not done (and it is seldom done) the designer should make up a list of these ratios and submit them for approval before he draws in his heaters; unless he cares to run chances of having

Generated on 2024-09-12 07:30 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

his entire plans badly mutilated after everything is finished and shown in ink, for his heaters may be too large or too small, which would not only affect the location of some of them, but would probably change the sizes of steam and drain leads from the engine room manifold throughout the ship and back again to the terminus of the drains, and thus he would have a good share of his work to do over again. This is unnecessary delay in the grossest sense of the word.

The writer knows of no universal standard list of ratios; in fact, it would not be good practice to stick to one such list for all cases, as the designer must be guided by his own judgment. Inside rooms, for instance, do not need as much heat as those having two or three sides exposed to the wind, and an isolated room would need a much higher ratio than one located next to the galley or the boiler hatch. The list given in Table I. can, however, be followed for most cases and a deviation from these figures is advisable only where the ship travels in an exceptionally cold climate.

Table I. Approximate Ratios.

Deck.	Rooms.	Ratio.
Boat	Pilot house	40
	Chart room	75- 80
	Captain's office	75- 80
	Captain's bath	90-100
	Officers' staterooms	75- 80
Promenade	Smoking room	100
	Staterooms	80- 90
	Offices	80- 90
	Toilet rooms	110-115
	Baths	70- 80
Hurricane	Dining saloons	90-100
	Cabins	90-100
	Staterooms	90-100
	Toilet rooms	110-115
	Baths	70- 80
Main	Crew's quarters forward	50- 75
	Staterooms forward	50- 75
	Mess rooms	125
	Staterooms aft	75-100

The pantries, galley, bakery, crew's and firemen's lavatories and showers, and the store rooms are usually not heated directly, since they receive enough heat from other sources. The above ratios are known as "approximate ratios." Before making out the actual ratios it is necessary to say a few words about the sizes and types of heaters.

Standard wall radiators are made by the Fowler & Wolfe Company and by the Pierce, Butler & Pierce Manufacturing Company in the following sizes:

Square Feet of Heating Surface.	Dimensions in Inches.	Thickness in Inches.
3¼	9 x 17	3¼
5	12½ x 17	3¼
6	12½ x 21	3¼
7	12½ x 24	3¼
9	13 x 24	3¼

Other radiators can be had in all styles and sizes up to almost any number of square feet heating surface, but these flat wall radiators are best adapted, for the state rooms at least, as they do not extend more than five inches out when fitted to a wooden bulkhead, and on a steel bulkhead, where no fire protection is needed, they extend out only 3¾ inches. They come in either the horizontal or vertical pattern and can be made up in sections of any size. For instance; if 12 square feet of heating surface are required, two 6-foot radiators may be put together, making a section 12½ inches high by 42 inches long, or 25 inches high by 21 inches long, or 21 inches high by 25 inches long, or 42 inches high by 12½ inches long, with only one steam and one drain valve to the entire section. Thus it will be seen that these little radiators readily adapt themselves to any size of wall space, though when used in multiples they should be so ordered from the manufacturers. But we will get to this later on.

These radiators are used in the state rooms and officers' quarters, where appearance counts. For the firemen and crew and steerage quarters it is cheaper to use coils made of 1-inch black or galvanized wrought-iron pipe with return bends, unless specifications state otherwise. The pilot house is generally furnished with brass coils of 1-inch pipe, iron pipe size.

To determine the number of square feet of heating surface in a coil, multiply the outside circumference of the pipe in inches by the length of coil over all in inches by the number of rows of pipes in the coil and divide by 144. Thus: a coil of 1-inch pipe 36 inches long and eleven rows high will have

$$\frac{4.131 \times 36 \times 11}{144} = 11.36 \text{ square feet.}$$

Very frequently the crew's sleeping quarters are so well filled with berths, lockers, etc., that no space is left on the bulkheads or sides for coils. It is then well to install one or more large circular radiators in the middle of the room. These radiators can be bought in halves and fitted around a stanchion if necessary. Such an arrangement works out very well and is also much cheaper than using many coils.

We are now ready to make up our list of radiators, coils and actual ratios. This is done by locating standard size radiators and convenient size coils to scale on the joiner plan, and approaching as near as possible the approximate ratio. This may be done with a soft black or a red pencil, as it is for the draftsman's use only, and as will be seen later, it saves an immense amount of work.

Care should be used in locating the heaters so that they do not come on the outside bulkhead of a cold-storage room, or in the wake of a sliding door, or block a passage. This may seem ridiculous to say, but the writer has seen it done time and again. The number of heaters in a room or passage should also be cut down to as few as possible, as heaters cost money and one large heater will give less trouble than several small ones. Sizes and dimensions of sectional and circular radiators will be found in any manufacturer's catalogue. Steam and drain tappings should be determined from Table III. The list of ratios should be made up similar to the one shown in Table II., which was used on a very recently completed vessel of moderate size. The list made up in this form will give all the information required regarding heaters and will save time in making up the orders in the purchasing department as well as in cutting lengths of pipes for the coils. Note the slight difference between the actual ratios in this list and the approximate ratios in Table I.

This list should now be forwarded for approval.

Tracing the Ship Work.

While the list of radiators, coils and ratios is away for approval, the draftsman should lay down the lines of the ship. This should be done directly on cloth and to any convenient scale, the lines being traced directly from the joiner or arrangement plans. The pilot house and all decks with living spaces should be shown, as well as the holds through which steam or drain leads may pass. Most drawing rooms also require an inboard profile; but the writer does not see the good of this, as the pipes, when several appear in a row, cannot be shown to scale and must be grossly exaggerated. Cross sections would be of much better use and are more appreciated by the men who install the work.

Considerable neatness should be shown in tracing the ship-work, though no waste of time should be allowed. Fine lines only should be used. The frames at the side of the ship need not be shown, but where web frames occur they should be drawn in. Steel bulkheads should be shown in single lines; wooden partitions in double lines. This is to guide the workmen on the ship. All doors and all furniture should be shown, as well as all hatches and ventilators.

Generated on 2024-09-12 07:32 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Where quarters are paneled, it is well to show it for general convenience, as pipes must be hidden from view in these quarters. The writer finds it good practice to trace in the steering gear leads in fine blue lines and to show the stiffeners on all steel bulkheads, as well as the knee brackets at the sides; also the bulkheads below the deck. The latter may be shown in very fine blue lines that will not show up on the blue print, as they are for the draftsman's use only. They save an immense amount of work in running the drains, as once they are shown in it is not necessary to refer to the steel plans, as would otherwise be the case. Where drawers occur under the berth the draftsman should find out how much space they will occupy and show them in, and make sure that they will clear his heaters.

The writer remembers very well a time when he failed to do this. The heaters were installed very close to the berths and before the drawers were in place. The heaters projected five inches out from the bulkhead, while the drawers would have allowed only four inches. When the joiners tried to get the drawers in place (which was almost at the last minute, before the ship left the yard) the combination would not work and twenty-seven drawers went back to the shop to be cut shorter and practically made over.

Thus it will be seen that too great care cannot be used in showing or indicating everything that may foul the heaters or the leads to and from them. Even the voice tubes and bell pulls should be looked into. It takes but little time to do this in the office and pushes work wonderfully out in the yard, and the draftsman that makes the best showing in this respect is the man that gets promotion.

LOCATING THE HEATERS.

With the ratios approved (we will assume that they have been approved and returned by this time) and the ship work all traced, we now have a clear course and can go at "full speed ahead." So we draw the heaters to scale in every room, simply tracing them from the joiner plan. Most draftsmen mark the size and type of each radiator on the plan as they go along. This is not good practice, as it is extra work and often leads to confusion when changes occur on the plan.

The simplest and quickest way is to simply label the rooms. All necessary information can then be quickly found on the list of radiators, coils and ratios, and when a change occurs in the size of heaters, it is only necessary to change the list; the plan will not be affected at all.

CIRCUITS.

The system is usually divided off into circuits as follows:

Circuit No. 1.—Steam to galley, pantry and sinks and steam and drain to bath-room water heaters.

Circuit No. 2.—Steam and drain to chart room and pilot house, and all rooms on boat deck.

Circuit No. 3.—Steam and drain to first class quarters.

Circuit No. 4.—Steam and drain to second class quarters.

Circuit No. 5.—Steam and drain to steerage and crew's quarters.

The lower deck, being all store rooms and holds, would not require any heat.

Steam to these circuits is supplied through a manifold (Figure 1), which should be located at a very accessible place in the engine room. Steam should be taken from the auxiliary steam line at not more than one hundred pounds pressure. The reducing valve at the manifold will then reduce from one hundred pounds to ten pounds, which is sufficient for the average heating system. The relief valve should be the same size as the steam-supply valve and should be set at about fifteen pounds.

Sizes of pipes and valves may be made up from the following table, which also determines the sizes of steam and drain tappings on the heaters:

TABLE II. RADIATORS—COILS—RATIOS.

Deck.	Room.	Cubic Feet Space.	Ratio.	Number of Heaters.	Type.	Square Feet H. S.	Description.	Steam and Drain.
								Inch.
Boat	Pilot house	825	41	1	Coil	20	11 rows 1-inch brass pipe 64 inches long, over all	½
	Chart room	1,352	75	1	A	18	9 square foot sections, horizontal pattern, 2 high	½
	Captain's office	1,352	75	2	A	9	Vertical pattern	½
	Captain's bath	348	92	1	A	3¾	Vertical pattern	½
	1st officer	603	80	1	A	7½	3¾ square foot sections, horizontal pattern, 2 high	½
	2d and 3d officers	494	82	1	A	6	Vertical pattern	½
	Officers' bath	348	92	1	A	3¾	Vertical pattern	½
Promenade	Smoking room	4,375	104	1	B	42	45 inches high, 17½ inches long, 9¼ inches wide at base	¾
	Chief engineer	610	87	1	A	7	Vertical pattern	½
	Wireless telegrapher	314	84	1	A	3¾	Vertical pattern	½
	20 inside staterooms	Approx. 493	82	20	A	6	Vertical pattern	½
	16 outside staterooms	Approx. 396	80	16	A	5	Vertical pattern	½
	Men's toilet	1,018	113	1	A	9	Vertical pattern	½
	Women's toilet	862	115	1	A	7½	3¾ square foot sections, horizontal pattern, 2 high	½
	2 bath rooms	252	70	2	A	3¾	Vertical pattern	½
Hurricane	1st class dining room	7,896	90	2	B	44	32 inches high, 27½ inches long, 9¼ inches wide at base	¾
	2d class dining room	11,342	90	2	B	63	39 inches high, 30 inches long, 9¼ inches wide at base	¾
	Cabin	5,085	97	2	B	26	39 inches high, 12½ inches long, 9¼ inches wide at base	¾
	26 outside staterooms	412	82	26	A	5	Vertical pattern	½
	24 inside staterooms	345	92	24	A	3¾	Vertical pattern	½
	2 1st class toilets	968	107	2	A	9	Vertical pattern	½
	2 2d class toilets	896	119	2	A	7½	3¾ square foot sections, horizontal pattern, 2 high	½
	2 2d class baths	293	78	2	A	3¾	Vertical pattern	½
Main	Crew's quarters	2,851	55	1	B	52	Circular	¾
	Quartermasters	896	55	1	B	16	32 inches high, 10 inches long, 9¼ inches wide at base	¾
	Waiters	2,570	100	1	B	26	39 inches high, 12½ inches long, 9¼ inches wide at base	¾
	Firemen	3,664	125	1	B	30	45 inches high, 12½ inches long, 9¼ inches wide at base	1
	Firemen's mess	638	125	1	Coil	5	9 rows 1-inch pipe 19½ inches long over all	¾
	Crew's mess	638	125	1	Coil	5	9 rows 1-inch pipe 19½ inches long over all	¾
	Officers' mess	843	125	1	Coil	7	11 rows 1-inch pipe 22 inches long over all	¾
	Engineers' bath and watercloset	651	110	1	Coil	6	11 rows 1-inch pipe 19½ inches long over all	¾
	Cooks	489	100	1	Coil	5	9 rows 1-inch pipe 19½ inches long over all	¾
	Messmen	489	100	1	Coil	5	9 rows 1-inch pipe 19½ inches long over all	¾
	Porters	384	100	1	Coil	3¾	7 rows 1-inch pipe 19½ inches long over all	¾
	1st assistant engineer	493	100	1	Coil	5	9 rows 1-inch pipe 19½ inches long over all	¾
	2d and 3d assistant engineers	493	100	1	Coil	5	9 rows 1-inch pipe 19½ inches long over all	¾
	Oilers	618	100	1	Coil	6	11 rows 1-inch pipe 19½ inches long over all	¾

"A" indicates flat wall radiators. "B" indicates Bundy or Walworth radiators or similar.

Generated on 2024-09-12 07:28 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

TABLE III.

0– 10 square feet heating surface	¾ inch pipe.
11– 35 square feet heating surface	1 inch pipe.
36– 80 square feet heating surface	1¼ inch pipe.
81–175 square feet heating surface	1 inch pipe.
176–450 square feet heating surface	1½ inch pipe.
451 and above	1½ inch pipe.

This schedule should determine the sizes of all the pipes throughout the ship, the size of reducing valve at the steam manifold and the drain trap. Before running the steam lines it will be necessary to detail the manifold (Figure 1) at

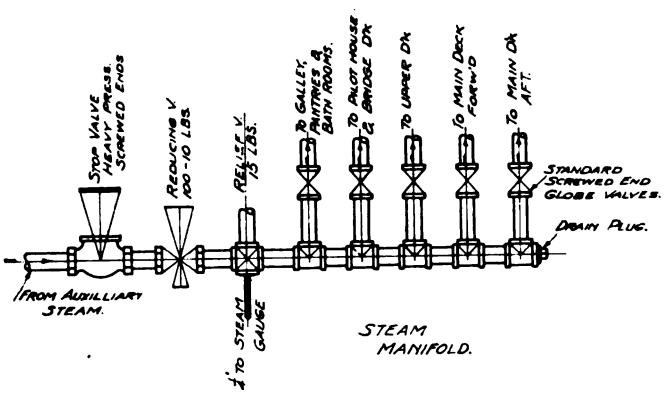

Stop Valve Heavy Press. Screwed Ends
Reducing V. 100-10 Lbs.
Relief V. 15 Lbs.
To Galley, Pantries & Bath Rooms.
To Pilot House & Bridge Dk.
To Upper Dk.
To Main Deck Forw'd
To Main Dk. Aft.
Standard Screwed End Globe Valves.
Drain Plug.
From Auxilliary Steam.
To Steam Gauge
Steam Manifold.

FIG. 1.

about 1-inch scale and locate it so you will have some definite place to start from. As soon as this is done the reducing valve, relief valve and drain trap should be ordered. We are now ready to draw in the pipes, paying no attention to sizes whatever.

Steam pipes should run overhead—drain pipes under the deck, if possible. Care should be used to avoid water pockets. Where such pockets occur, a drain tee must be fitted. All pipes should be perfectly accessible and expansion bends put where necessary. Where pipes pass through steel decks or bulkheads the holes should be carefully located on the plating plan and then shown to scale on the pipe drawing. In doing this it will often be found impossible to get the pipes through where before it seemed an easy matter. A new location must be found and thus trouble is avoided on the ship. In the crew's quarters the overhead pipes should be kept outboard as far as possible, to allow for overhead storage of mess tables and benches. The drain pipes from the after circuits should drain to a manifold in the engine room (Figure 2), and those from the forward circuits to a similar manifold in the boiler room. From these manifolds a single pipe should lead to a trap conveniently located in the engine room, and piped as shown in Figure 3. The discharge from this trap may lead to the feed and filter tank, or as otherwise directed. The writer prefers to connect to the condenser, as it is then possible to open the by-pass valve and suck the entire system clean and dry before laying it up. The drain manifold should be located several feet below the lowest heater and the drain trap below the manifold. The drain pipes from the heaters to the trap should have a steady drop, and where this can not be accomplished, check valves should be fitted to prevent the water from backing up into the heaters.

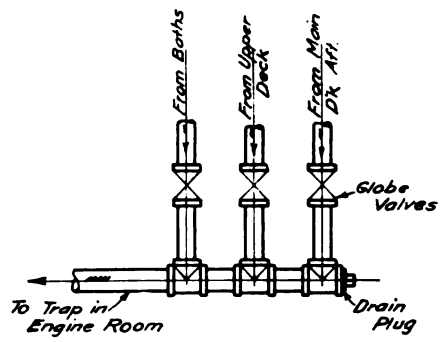
With the steam and drain lines all shown, the next step is to mark the sizes of pipes. This is done by adding together the square feet of heating surface of all heaters on each branch and obtaining the corresponding size of pipe from Table III.

FINISHING UP THE PLAN.

Everything is now completed except the notes governing the work and a list of reference plans. For the former, each shipyard has its own method and it is hard to give a definite outline. In general, notes may read about as follows:

NOTES FOR HEATING SYSTEM.

Pipes and coils in pilot house to be brass,* all other pipes wrought iron, standard weight, black.* All other coils 1-inch wrought-iron pipe, standard weight, black. Coils fitted with return bends. All heaters tested to two hundred pounds pressure. Valves and manifolds to be* Lunkenheimer regrinding, screwed ends. Valves on radiators and coils to be standard radiator valves, with wooden-rim hand wheels. Brass fittings for brass pipe, cast-iron fittings for wrought pipe. Union



DRAIN MANIFOLD.

FIG. 2.

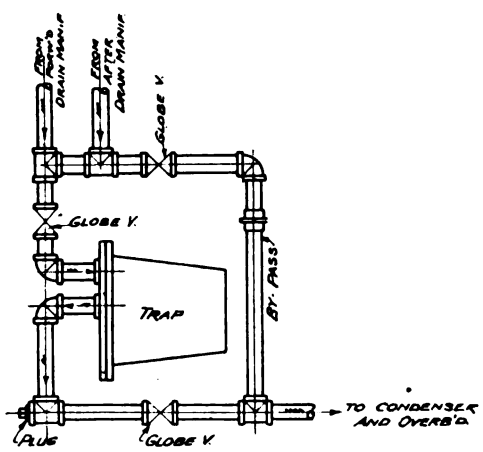


FIG. 3.

couplings to be ground joint. All fittings taken from stock. Heaters to be made up as per list of radiators, coils and ratios.

Reducing valve ordered on requisition number.

Relief valve ordered on requisition number.

Drain trap ordered on requisition number.

Steam gage taken from stock.

Where heaters are secured to woodwork, the same to have a sheet-iron plate fitted one inch from woodwork for fire protection.

Drip pans fitted under radiator valves.

Pipes passing through wooden decks or bulkheads to be thimbled with lead, and where they pass through water-tight decks or bulkheads to be made water-tight.

Leads of pipes and location of heaters are only approximate and must be run to best advantage on the ship.

REFERENCE PLANS.

Arrangement boat and promenade decks.

Arrangement hurricane and main decks.

Arrangement stanchions.

Arrangement steering gear leads.

* It is assumed that this material is not governed by specifications.

Generated on 2024-09-12 07:32 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Arrangement drainage and deck piping.
Arrangement ventilation.
Arrangement voice pipes and bell pulls.
Arrangement electric wiring.
Ladders and gratings in engine room.
Ladders and gratings in boiler room.
Piping in engine and boiler rooms, elevation.
Piping in engine and boiler rooms, sections.

The plan is now complete in every detail and may be sent away for final approval. As the list of radiators, coils and ratios is already approved, the standard radiators may be ordered at once, just as they are described on the list. The list contains all the information the manufacturer needs and will do away with all confusion and unnecessary work. Without this list it would be almost impossible to get the heaters to fit. The coils can be made up from this same list in quick time and the piping ordered, and, when the plans are returned approved (or with very slight changes), everything will be ready for installation and there is no possible excuse for delay. There will be no trouble for the draftsman with heaters that are too long or too high, or pipes that foul other work, and the draftsman can work in peace on his next job and forget all about the heating system he has just completed.

THE DEVELOPMENT AND PRESENT STATUS OF THE EXPERIMENTAL MODEL-TOWING BASIN.

BY H. A. EVERETT, S. B.

The Tank at the Yards of Wm. Denny & Bros., Dumbarton.

The oldest private tank in the world, and probably the one with the largest accumulation of merchant ship data in existence, was built upon the suggestion and under the direction of Mr. Wm. Denny, 1882-1884. As may be seen from the cut (Fig. 4), the carriage has a very small span (4 feet) and travels along tracks suspended from the trussed roof. As the carriage is a light wooden one (about 1,100 pounds), with the recording instruments small and compact, the original method of driving the carriage is still retained, which consists of a rope attached to the carriage and wound up on a drum by a steam engine at one end of the tank. Needless to say, it is essential in any tank that is to attempt accurate work that the towing speeds of the carriage must cover an extensive range, and be absolutely constant on each speed. Apparently this especially designed engine gives satisfactory results for a carriage as light as this one, as there is no intention of substituting the electric drive as adopted in the newer stations, and speeds up to 1,200 feet per minute are obtained.

The general method of preparation and material of the models is practically the same in all the European stations, though the length (here 12 feet) varies somewhat, and can be described once for all. The models are of paraffine, toughened by a small amount (1 percent) of beeswax,[8] cast approximately to the form of the hull and finished to exact shape later.

A rectangular tank, larger than the over-all dimensions of the models, is first filled with modeling clay, and by means of molds of the transverse stations or frames, a hollow is scooped out, having the form of the outside of the hull plus the thickness allowed for finishing down. (See Fig. 5.) A core of light wooden strips is made, also to the form of the model, but *smaller* by the thickness the casting is to have, usually from 2 to 3 inches. This core is covered outside with cloth and plastered inside with clay to make it impervious to the hot paraffine. Fig. 5 shows the tank with the mold scooped out and with the core model ready to go in. Next, the core model is suspended in place, and the paraffine run into the space between the core and the mold; at the same time water is filled into the inside of the core to counteract the hydraulic pressure of the paraffiine and to aid in cooling.[9]

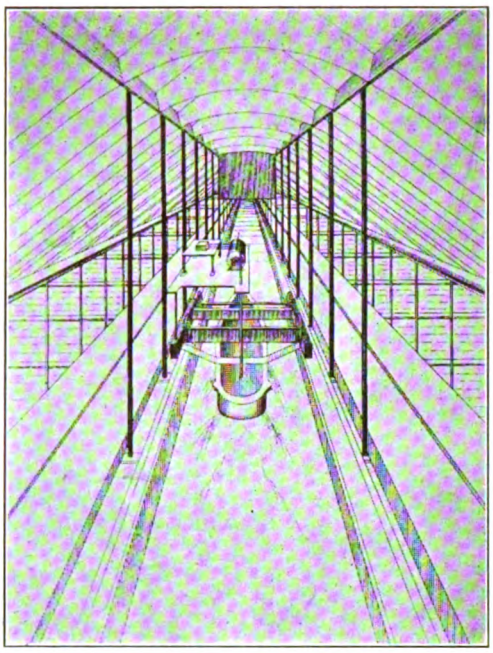


FIG. 4.—INTERIOR OF TANK AT WM. DENNY & BROS.'

When sufficient paraffine has flowed in, the stream is almost entirely shut off. A small amount is still allowed to trickle into the pot hole to make up for loss by shrinkage. When the surface of the paraffine has solidified enough to withstand pressure, the head of paraffine in the pot hole is increased, to provide an automatic supply to balance shrinkage. The model is then left to cool, which takes from 15 to 24 hours, according to size, the core taken out and the top of the model leveled off perfectly flat, the tops of the casting-box sides serving as guides. Wooden members are fitted to the model to strengthen it and provide an attachment for the towing mechanism. A small depression is made on the surface of

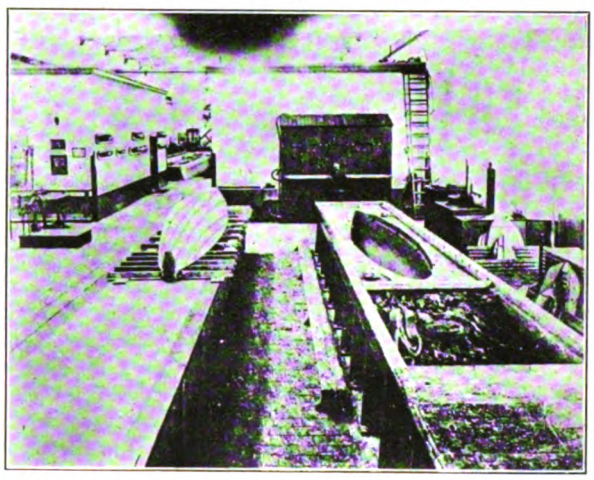


FIG. 5.—CLAY CASTING MOLD WITH FORM SCOOPED OUT AND CORE READY TO GO IN.

[8] Pure paraffine shrinks very considerably on cooling, so that it cracks and tears away from itself. The beeswax minimizes this and makes the casting less brittle and less liable to chip when put through the cutting machine.

[9] The depths of the two liquids are maintained inversely proportional to their densities, to prevent deformation of the core.

Generated on 2024-09-12 07:39 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

the clay next the side of the model, and water is fed into this from a hose, the water percolates between the clay and the model and soon the model is started from its bed by the buoyancy of the water, thus obviating the danger of breakage in starting the model from the mold and permitting ready attachment of the slings for transferring the model to the cutting machine, Fig. 6.

To shape a model accurately it is placed, bottom up, on the bed of a machine in which a pair of revolving cutters, one on each side of the model, cut out on its surface a series of level lines whose contours are precisely similar to the level waterlines on the drawing of the ship whose model is under treatment, Fig. 6. This machine was designed by William

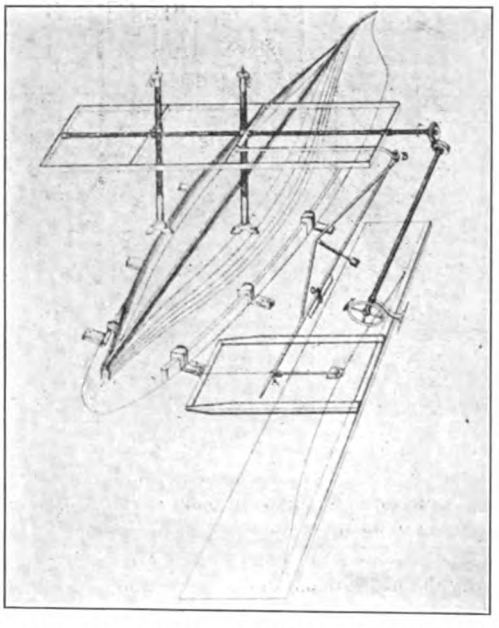


FIG. 6.—DIAGRAM OF FROUDE'S MODEL CUTTING APPARATUS.

Froude, and, with some modifications suggested by his son, is practically in universal use where paraffine is used for models. It is similar to a planer, in that it has a flat bed carrying the model, keel up, moving backward and forward. There are two swiftly revolving (1,500 revolutions per minute) two-blade cutters constrained by a pantograph linkage to move apart or together as guided from the side of the machine. (See Fig. 6.) A tracer disc is offset to this side and has the same transverse movement that the guiding wheel gives to the cutters. A plan of the waterlines on a side table travels back and forth under the tracer disc with the same motion that the model has. It is the duty of the operator to keep the tracer disc in contact with the plan of the waterline being cut, and if he does so the waterline is transformed to the model as the bottom of the groove cut. All the waterlines are cut in this way, beginning at the center and cutting toward the ends. A section through the model, when the machine has finished with it, presents the appearance of a series of steps, the inner angles of which represent the true form. (See Fig. 7.) The waterlines are about ½ inch apart at the bilge to 1 inch apart at the gunwale for a 12-foot model.

The model is then taken from the machine, the excess material, *i. e.*, the paraffine ridges, cut away, the model faired down to the horizontal waterline grooves and finally polished with rags. The details vary in every yard, but the above is the general method.

In the Denny tank at the north end are the general offices, drawing room, molding room (containing the modeling machine and casting boxes), a small machine shop and the finishing room, where the models are brought down to the lines. At either end of the tank are the small docks. The air in the building is heated by hot-water pipes along the sides, and the tank water (fresh) is supplied from the town mains (Dumbarton). All models are made of paraffine, except some light draft paddle boats, which are made of wood.

In the molding room there are two casting boxes large enough to take models up to 20 feet. There are three cast-iron tanks in which the paraffine is melted, the uppermost being used for cleaning the parafine, which has accumulated dirt by melting it with water, which allows the dirt to fall as a sediment, while the clean wax is drawn into the boxes below. Here also is the model-cutting machine. The station is under the direction of Mr. Leslie Denny.

The British Admiralty Tank at Haslar (near Portsmouth).

In 1885, when the land occupied by the Torquay tank was needed for building purposes, a new tank was constructed by the Admiralty at Haslar, near Portsmouth, from the designs of Mr. R. E. Froude, son of Wm. Froude. Mr. R. E. Froude had worked in conjunction with his father in the Torquay tank up to the time of the latter's death, and the new tank embodied the improvements which experience there had shown desirable. The carriage has a span of about 20 feet, and, to give it the necessary rigidity, it is made a built-up girder of wood in the form of hollow boxes cemented and screwed together (Fig. 2 shows it in diagram). It is drawn by a wire rope, wound upon a drum by a steam engine as described for the Denny tank, though there is some thought of applying electric traction. The carriage speeds range from 100 to 800 feet per minute, and an extreme speed of 1,200 feet can be obtained. The models are of paraffine, about 14 feet being the standard length, and an allowance of ¼ inch on thickness is customary for finishing down. When first installed, the longitudinal vibrations of the wire rope proved troublesome, as the car was considerably larger than those previously constructed, but the interposition of a hydraulic cylinder and

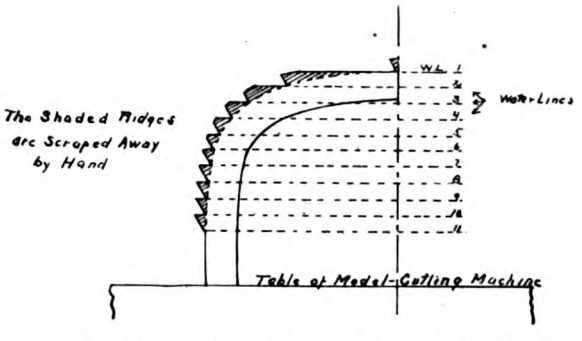


FIG. 7.—CROSS SECTION LEFT BY MODEL CUTTING MACHINE.

piston in the cable eliminated this. Here, as in all tanks using paraffine models, the models are submerged when not in use, to prevent change of form. The basin itself is 400 feet long by 20 feet broad by 9 feet deep, of concrete, and rectangular in cross-section, with a clear run for the carriage of about 360 feet. In addition to the regular model apparatus, a wave-making device has recently been installed in order to investigate the action of ships when propelled among waves. This tank occupies the same position of pre-eminence with regard to warship information and data that Denny's does with regard to merchant work. It is under the direction of Dr. R. E. Froude, and its contributions to the scientific literature of naval architecture, with those of its prototype at Torquay, have probably advanced this branch of science more than any other one thing in the past thirty-five years.

Generated on 2024-09-12 07:29 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

The Tank of the Italian Government at Spezia, Italy.

The Spezia tank, with the two just described (Denny's and the British Admiralty—if we consider the Torquay and its successor at Haslar as one), may be said to constitute the pioneer trio among tanks and the ones having at hand the greatest store of information. As a person's value increases in proportion to his experience, so does that of a well-conducted tank increase with its life. This tank (Fig. 8) was commenced in 1887 upon the recommendation of Mr. S. E. Brin, then Minister of the Marine, and was modeled upon that existing at Haslar, with the consent of the British Admiralty. The tank was completed and began operations in 1889; and though primarily for the Italian Government, it is frequently used for mercantile vessels by the principal Italian shipbuilding firms. The Governments of Austria-Hungary, Portugal and Germany have had naval work done here;

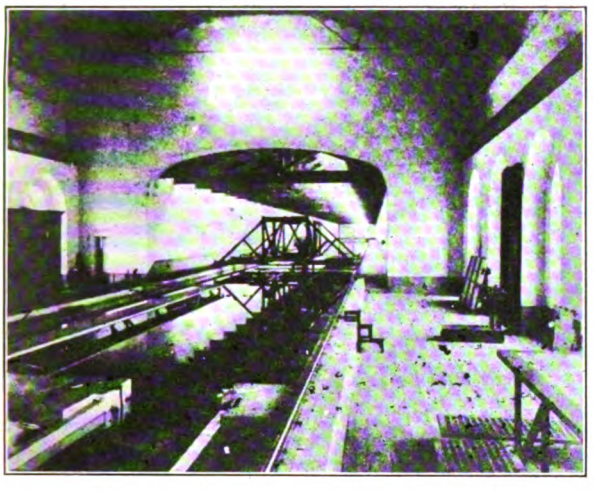


FIG. 8.—INTERIOR OF ITALIAN BASIN AT SPEZIA, ITALY.

though since the latter country has had similar establishments within its own borders it has relied upon its own resources.

The tank proper has a length on the water of 538 feet, with a free tow of 480 feet. It is 19.7 feet broad by 9.9 feet deep, approximately rectangular in cross-section and built of concrete (Plate II.). It has a light wooden roof over it, and the rails for the towing car are laid along the top of the sides of the concrete tank. The carriage, very similar to that at Haslar, is of wood, in the form of two vertical trusses basing on the horizontal frame work that is carried by the four wheels (Figs. 2 and 9); it is 26.25 feet long by 22 feet broad (span) by 7.2 feet high. The apparatus for propeller work is on this carriage, with the hull apparatus, instead of on a separate car coupled to it, as in some of the earlier tanks. The winding engine is stationary at the head of the tank and is controlled from a platform nearby; this is capable of giving the car any speed up to 1,000 feet per minute. The propeller mechanism (Froude's pattern) is capable of testing as high as quadruple screws, and the model propellers themselves are made from large-sized drawings photographically reduced to the desired scale. Wooden patterns are used for casting, instead of the plaster of paris "swept up" mold of the British tanks. This tank, next to that at Washington, has the highest average temperature, single days sometimes as high as 95 degrees F. Vegetable growth in the water gave some trouble until sulphate of copper (1:300000) was tried with entire success. For scumming the surface of the tank, a wooden bridge spanning the tank in a zig-zag line is drawn from end to end. Much of the data of this tank have been published in a book by Lieutenant-Colonel G. Rota, *"La Vasca,"* per *"Le Esperienza di Architettura Navale."*

Tank of the Russian Government near St. Petersburg.

Shortly after the completion of the Italian tank, the Russian Government established one very similar near St. Petersburg, which began operations in 1893. This tank is 440 feet extreme length, with a clear run for the carriage of 374 feet (Plate I.). It is modeled closely after that at Haslar, and is of concrete, with a breadth of 21.8 feet and a depth of 11 feet. The models are of paraffine, 12 feet long, and the carriage for towing spans the tank and travels on rails along the sides. The propeller and resistance apparatus are modeled after those at Torquay and are of the regular Froude type.

United States Government Tank at Washington, D. C.

The tank of the United States Government (Fig. 10) at Washington was completed in 1899 and contains several novel features wherein previous practice has been radically departed from, chief of which are the making of the models of wood instead of paraffine and the increase of the standard model length to 20 feet, the reasons for which will be given later. The tank itself (See Plates I. and II.) is 470 feet long by 42.7 feet wide on the water surface by 14.7 feet deep, and the carriage, which has a span of 47.5 feet, is of steel, the heaviest (70,000 pounds) of any tank yet built."[10] The building over the tank is 500 feet by 50 feet, heated by hot air in winter, and is provided with an automatic device for opening and closing the windows to maintain a constant temperature. The cross-section of the tank (Plate I.) has sloping sides with flat tops, and just below the surface of the water on each side are placed steel troughs about 12 inches square (not shown in the cut) to serve as waves absorbers. The carriage (Fig. 10) is of built-up steel girders, electrically driven by four motors connected to the 30-inch

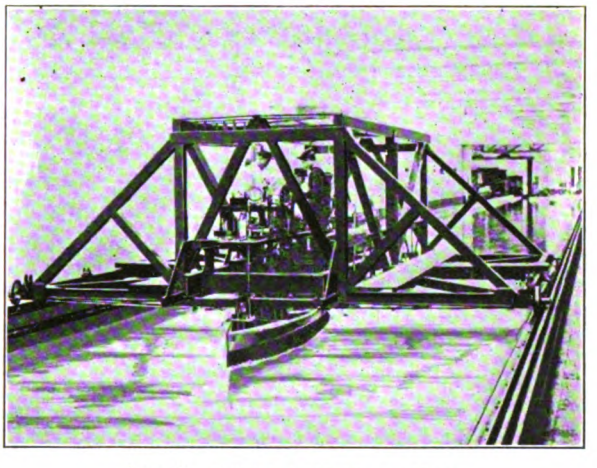


FIG. 9.—TOWING CARRIAGE AT SPEZIA.

driving wheels, and especial pains were taken in the electrical arrangements to secure uniform speed for the carriage. The carriage speeds range from 2 feet to 2,000 feet per minute.

The high temperature prevailing at Washington at certain seasons of the year made the use of paraffine for models out of the question; and after investigation, wood (white pine) was decided upon. Naval Constructor D. W. Taylor, who is in charge of the tank, speaks of the relative advantages and disadvantages as follows (The United States Experimental Model Basin, Proc. Soc. N. A. and M. E., 1900): "Wood retains its shape better. Wood is many times stronger." But "Wood is more difficult and expensive to fashion. Wooden models are harder to keep tight. Wooden models are harder

[10] The carriage was purposely made very heavy, to minimize slight irregularities in speed by the fly-wheel effect its momentum would have.

Generated on 2024-09-12 07:38 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

to give a uniform surface. The first and second objections have been practically overcome by the adoption of special machinery, and the third by using a special varnish to finish the models, which gives a surface practically uniform." The increase of the standard model length was adopted to decrease the gap which the laws of similitude must bridge between the model and the actual ship; and with wood for the model material, 20-foot models could be made amply strong, and the basin and towing carriage are larger than preceding tanks in proportion.

FIG. 10.—INTERIOR OF U. S. GOVERNMENT TANK AT WASHINGTON.

The wooden model is cut from a block built up of white pine lifts about 2 inches thick, glued together (hot) under hydraulic pressure and so proportioned that the minimum thickness of the model, when cut, will not be less than 2 inches. A "former" model (Fig. 12) is built of templates cut to the form of the transverse stations and planked with a skin of strips of wood which has the exact form the model will have. The former model and the block to be cut are placed in the cutting machine (Fig. 14), and the moving of a guide wheel along a transverse station guides the cutting saw along a similar path on the block model. The excess material is knocked away and the cuts brought exactly to form by the substitution of a rotary cutter for the saw. The model is then finished by hand, varnished and measured (Fig. 13), and from these final measurements a body plan is drawn and compared with the original to make sure of its accuracy.

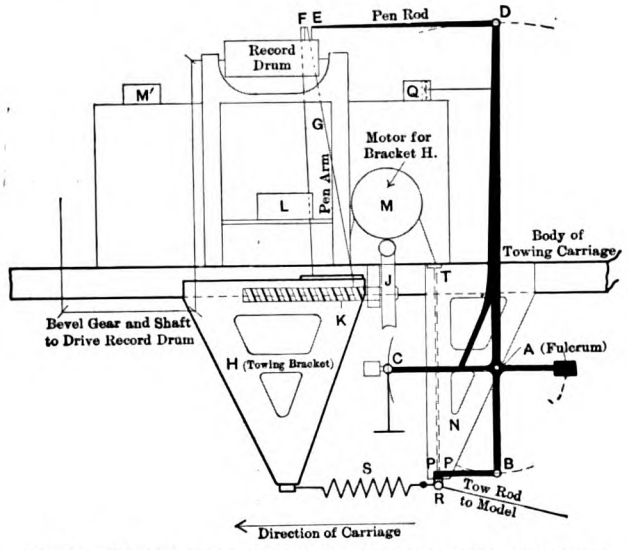


FIG. 11.—DIAGRAM OF APPARATUS FOR RECORDING MODEL RESISTANCE AT WASHINGTON.

The water for the tank is supplied from the Washington city mains and is treated with alum, before entering the tank, to coagulate the mud, after which it passes through sand filters. The capacity of the tank is 1,000,000 gallons; it can be emptied in 4 hours and filled in one week, as the filtering takes considerable time. The tank is scummed by a 4-inch centrifugal pump from the side tanks.

The resistance-recording apparatus on the carriage is quite different from the Froude apparatus previously described. The model is towed from the spring *S* (Fig. 11) attached to the movable bracket *H*, which carries the recording pencil *F* on the arm *G*. The motor *M* automatically forces the bracket *H* forward, when a pull is applied at *R*, until the spring draws the pencil *E* connected to its after end by the linkage *E D A B* back to its initial or zero position; and always the deflection of the spring or its equivalent, the pull of the model, is shown by the distance between the lines drawn on the drum by the two pencils *E* and *F*. The motor moves the bracket *H* by means of a worm and wheel *J*, turning the screw *K*. On either side of the towing cross-head at the after end of the spring are the contacts *P*, and *P*, by which the motor is controlled automatically; and as the distance between them is

Generated on 2024-09-12 07:29 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

slight, the line traced by the pencil E is practically a straight line.

The propeller-recording apparatus is also quite out of the ordinary run and consists of a transmission dynamometer driven by an electric motor for determining the power delivered to the propeller shaft, a traction dynamometer for determining the pull exerted by the propeller, and a revolution counter with a break-circuit chronometer for speed and time records. The first two are carried in a scow-shaped boat, rigidly attached to the towing carriage, and are in line with the propeller shaft.[11]

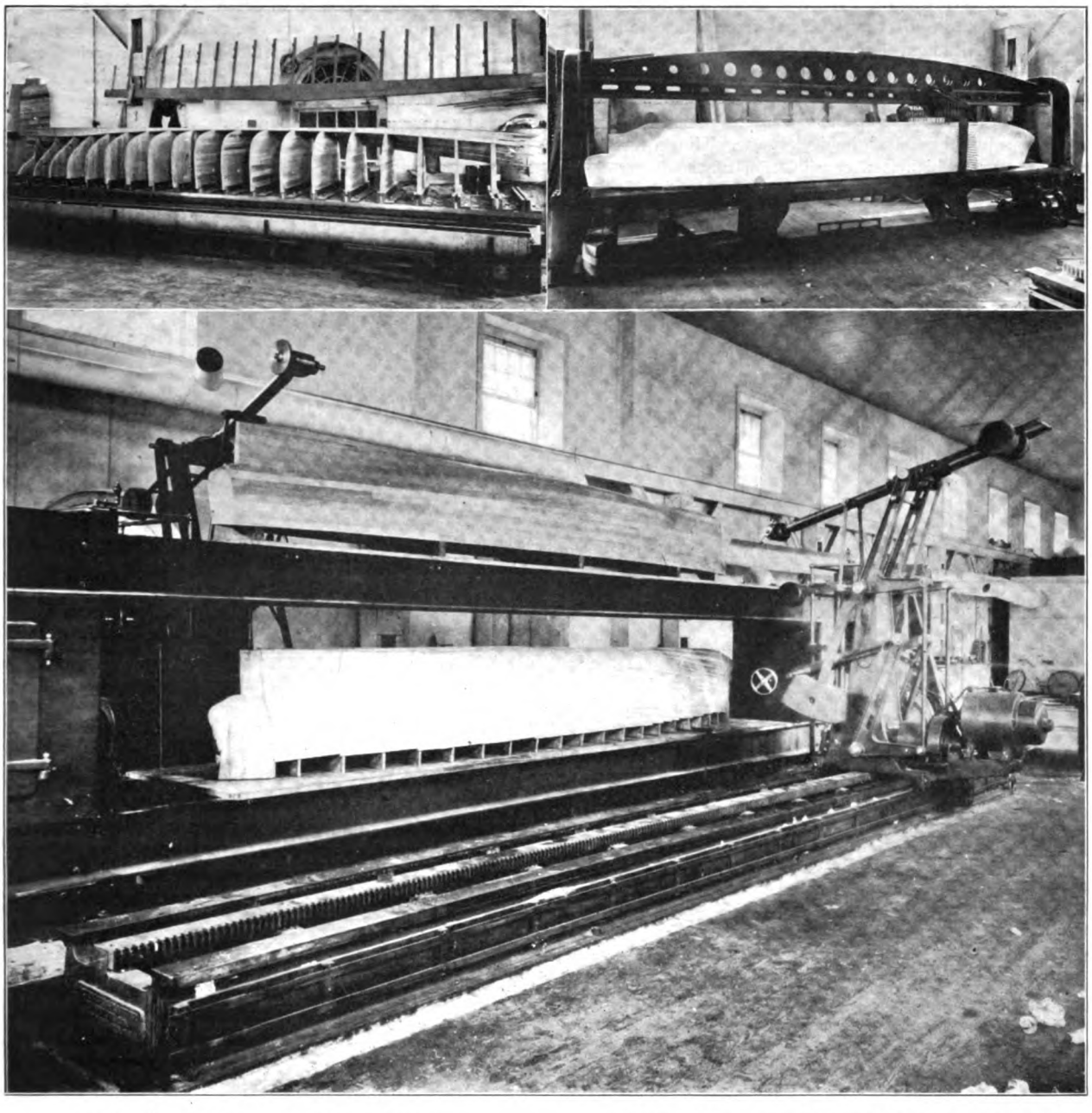


FIG. 12.—"FORMER" MODEL UNDER CONSTRUCTION.

FIG. 13.—APPARATUS FOR MEASURING THE FINISHED MODEL.

FIG. 14.—MODEL CUTTING MACHINE, WITH "FORMER" AND MODEL IN POSITION.

The Tank at Cornell University, Ithaca, N. Y.

At Cornell University a station of minor importance was established about 1900 by utilizing a section of the canal of the hydraulic laboratory. This tank is 340 feet long by 16 feet wide by 10 feet deep, and is provided with water from the reservoir above through double shut-off gates and an intermediate lock or measuring chamber. The carriage spans the canal and is electrically driven by one 15-horsepower motor at speeds from 100 to 600 feet per minute. Most of the work done here has been with propellers, upon which extensive experiments have been carried out by Prof. Durand. The tank is not roofed over.

(To be continued.)

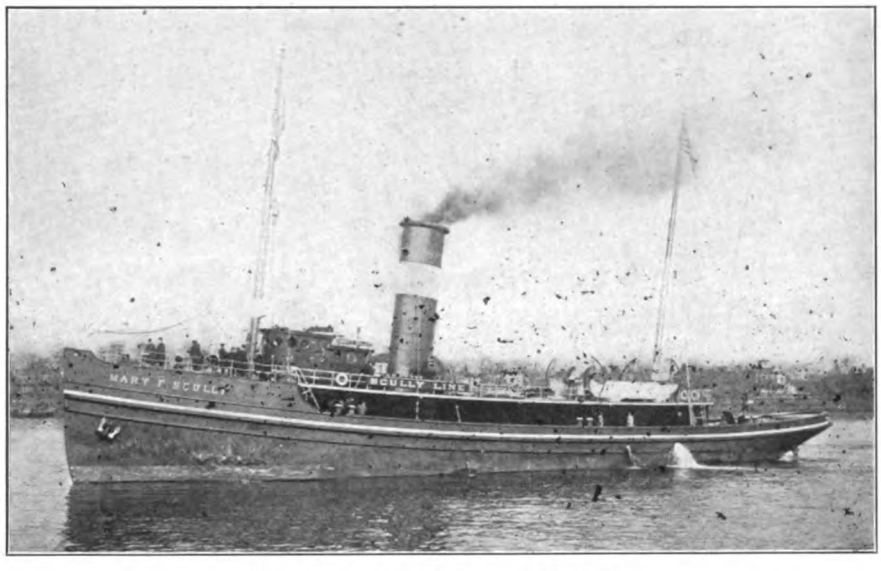
[11] For detailed description of this apparatus, see Proc. Soc. N. A. and M. E., 1904, p. 115.

Theoretically, an increase of vacuum from 24 to 28 inches should increase the power developed from 1 pound of steam by about 18 percent. With some types of turbines it is claimed that the actual gain is very nearly equal to the theoretical gain, but in common practice a reduction in the steam consumption of about 17 percent may be expected.

Generated on 2024-09-12 07:35 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

A LARGE SEA-GOING TUG.

With one exception the new steel ocean-going tug *Mary F. Scully*, built and engined by the Staten Island Shipbuilding Company, Port Richmond, N. Y., for Scully's Towing & Transportation Line, New York, is the largest tug afloat. She is 180 feet long over all, with a molded breadth of 30 feet and a depth to the lowest point of sheer of 19 feet 3½ inches. The mean designed draft is 15 feet 9 inches. With a bunker capacity of 500 tons of coal, she has a steaming radius of 5,000 miles. Although built especially for service on the Atlantic coast, she is capable of voyaging to any part of the world without regard to weather conditions. For a distance of 37 feet aft from the stem, the sides of the boat are carried up to the level of the top of the deck house. Thus a forecastle deck is formed, which is a continuation of the upper deck, giving efficient protection for the boat in the heaviest weather. The space thus closed in forward of the deck house is utilized for the windlass, lamp room, paint lockers, stowage of cables, etc.



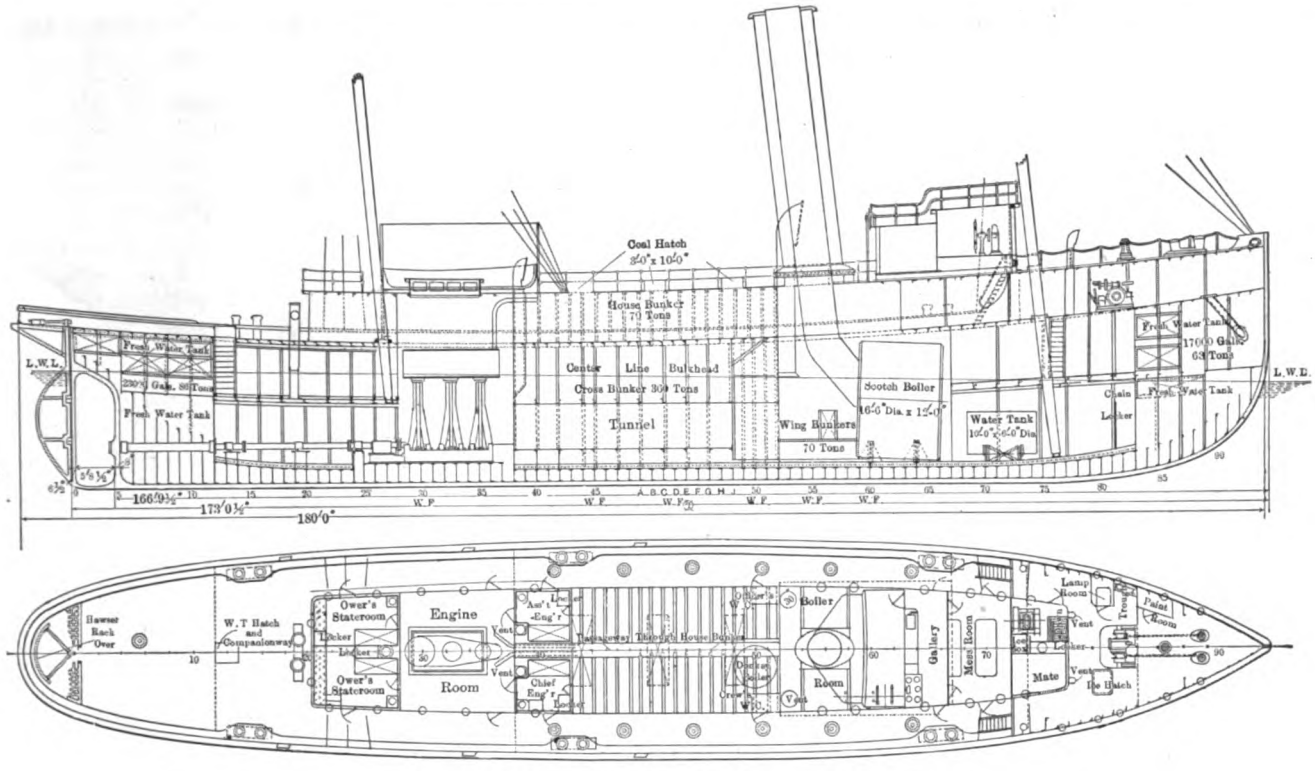
STEEL OCEAN-GOING TUG MARY F. SCULLY.

The hull is built of mild open-hearth steel, and is fitted with bilge keels, consisting of bulb angles 3½ by 9 inches by 22 pounds, reinforced with 3-inch by 3-inch by 7-pound angle-bars. The bar keel is 2 inches by 8 inches, and is fastened directly to the garboard strakes. The frames consist of 3-inch by 4-inch by 8½-pound angle-bars, spaced 20 inches apart throughout the length of the boat. Partial intermediate frames are fitted forward for a distance of 36 feet abaft the stem. The reverse frames extend alternately to 6 inches above the bilge keelsons, and to the under side of the main deck beams. Those in the engine and boiler rooms and coal bunker spaces are doubled from bilge keelson to bilge keelson. Web frames, built of 14-pound plate, 16 inches wide, reinforced on the inner side with double angles, 3 inches by 3 inches by 6 pounds, and secured to the lower deck stringer by diamond plates, 30 inches by 30 inches by 15 pounds, are fitted as follows: Two in the engine room, two in the athwartship coal bunker, and three in the boiler room. The main deck beams are of 3½-inch by 6-inch by 13.4-pound angles amidships, and 3½ inches by 6 inches by 11.6 pounds at the ends. The lower deck beams are 3½-inch by 6-inch by 11.6-pound angle-bars, fitted on every alternate frame. The main deck beams are joined to the shell by 16-pound brackets, 18 by 22 inches, and the lower deck beams are joined to the shell by 16-pound brackets, 18 by 18 inches. The main deck stringer is of 15-pound plate throughout the length of the ship. The lower deck stringer is of 14-pound plate, 16 inches wide, fastened to the shell by 3-inch by 3-inch by 7-pound angles, and reinforced at the inner edge by a 5-inch by 3½-inch by 12-pound angle, and at the inside edge of the frames by the same size angle-bar. Solid floors, 20 inches wide, of 16-pound plate, are fitted on every frame. In addition to a center keelson, built of 15-pound plate, 25 inches wide, reinforced by four angle bars, 4 inches by 4 inches by 9.8 pounds, and a 16-pound rider plate, there are two side keelsons of 16-pound plate, reinforced by double angles above the floors, 3½ inches by 6 inches by 11.6 pounds. The bilge keelsons consist of double angle-bars, 3½ inches by 6 inches by 11.6 pounds.

The general arrangement of the boat provides quarters for the crew on the lower deck forward, and for the stewards and oilers on the lower deck aft. On the main deck forward are the galley and mess room, while the chief engineer and assistant engineer are quartered on the main deck just forward of the engine room. In the after end of the deck house are two spacious staterooms for the owners. The engine and boiler rooms are separated by a large athwartship coal bunker capable of carrying 360 tons. In addition to this there is an additional athwartship coal bunker in the deck house with a capacity of 70 tons, and wing bunkers in the boiler room with an additional capacity of 70 tons. Three coal hatches are provided on top of the deck house, each 10 feet by 3 feet. A tunnel has been built through the deck-house coal bunker, giving a means of communication from the forward to the after part of the deck house. A similar tunnel through the main athwartship coal bunker provides a passageway from the engine room to the boiler room, so that any part of the boat may be reached without the necessity of going out on the deck. This is a feature which has never before been incorporated in a tugboat, and it is one which will undoubtedly prove of great value to the officers and crew, especially in cold and stormy weather.

The propelling machinery consists of a three-cylinder, triple-expansion, inverted marine engine, with cylinders 17, 27 and 45 inches in diameter by 36-inch stroke. The high-pressure and intermediate cylinders have piston valves, and the low-pressure cylinder a double-ported slide valve. All valves are operated by Stephenson link motion. The crank shaft is of the built-up type with steel shaft and pins, 9⅜ inches in diameter, and cast steel webs. The thrust shaft is 9 inches in diameter,

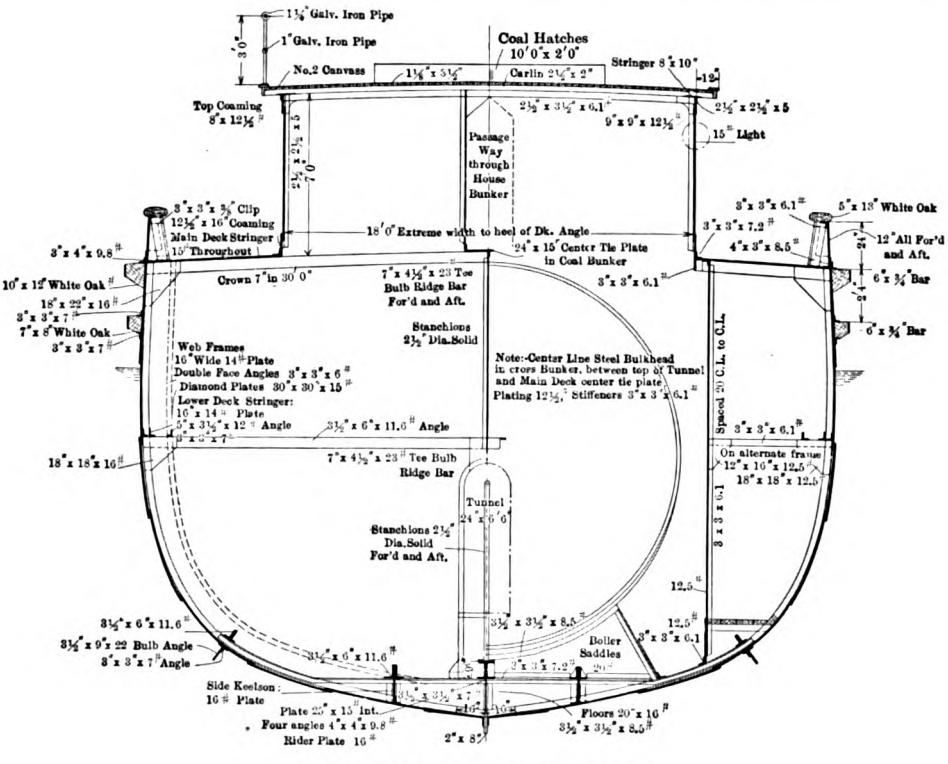
Generated on 2024-09-12 07:33 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN



INBOARD PROFILE AND GENERAL ARRANGEMENT OF THE MARY F. SCULLY.

with nine thrust collars; the thrust block is of the ordinary horseshoe type. The propeller shaft is 10 inches in diameter, with composition sleeves at the stuffing-box and stern bearings. A sectional propeller wheel, 10 feet 6 inches diameter by 13 feet 9 inches pitch, is fitted, having a cast iron hub and cast steel blades. The main engine is designed for an indicated horsepower of 1,200, to give the boat a maximum speed of 13 knots.

Steam is furnished by one Scotch boiler, 16 feet 6 inches in diameter and 12 feet long. The total heating surface is about 3,695 square feet, and the grate area 101 square feet, making a ratio of heating surface to grate area of 36.5 to 1. The working steam pressure is 180 pounds per square inch. There are four Morison corrugated furnaces, 44 inches inside diameter. Under ordinary conditions the boiler is to be run under natural draft, though, when necessary, forced draft may be


1¼" Galv. Iron Pipe
1" Galv. Iron Pipe
Coal Hatches
10'0" x 2'0"
No.2 Canvass
Carlin 2½" x 2"
Stringer 8" x 10"
Top Coaming
8" x 12½"
Passage Way through House Bunker
15" Light
3" x 3" x ⅜" Clip
12½" x 16" Coaming
Main Deck Stringer
15" Throughout
18'0" Extreme width to heel of Dk. Angle
24" x 15" Center Tie Plate in Coal Bunker
5" x 13" White Oak
12" All For'd and Aft.
6" x ¾" Bar
Crown 7" in 30'0"
7" x 4½" x 23 Tee Bulb Ridge Bar For'd and Aft.
Stanchions 2½" Dia. Solid
Web Frames
16" Wide 14# Plate
Double Face Angles 3" x 3" x 6#
Diamond Plates 30" x 30" x 15#
Lower Deck Stringer:
16" x 14" Plate
5" x 3½" x 12# Angle
3½" x 6" x 11.6# Angle
Note:-Center Line Steel Bulkhead in cross Bunker, between top of Tunnel and Main Deck center tie plate). Plating 12½, Stiffeners 3" x 3" x 6.1#
Spaced 20 C.L. to C.L.
On alternate frame
12" x 16" x 12.5
18" x 18" x 12.5
Tunnel
24" x 6'0"
Stanchions 2½" Dia. Solid For'd and Aft.
3½" x 3½" x 8.5#
Boiler Saddles
Side Keelson: 16# Plate
Plate 25" x 15" Int. Four angles 4" x 4" x 9.8#
Rider Plate 16#
Floors 20" x 16# 3½" x 3½" x 8.5#
2" x 8½"

MIDSHIP SECTION OF THE MARY F. SCULLY.

Generated on 2024-09-12 07:31 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

used, as a blower of the Sirocco type, driven by a steam turbine, is provided to furnish air under the grates. The air is heated by being drawn from the upper fire room up between the inner and outer shells of the stack on one side and down on the other side. A division plate between the two stacks directs the air along this path. From the stack the air is forced down around the up-take into the ash pit.

Besides the main boiler there is a donkey boiler, of the vertical tubular type, 68 inches in diameter and 12 feet high, designed for a working pressure of 100 pounds per square inch. This boiler is located in the lower fire room.

The auxiliary pumps are all of the Blake pattern, as follows:

One air pump, 7½ by 15 by 10 inches, vertical, single-acting, twin beam.

Two feed pumps, 8 by 5 by 12 inches, horizontal, simplex piston type.

One fire pump, 12 by 8½ by 10 inches, horizontal, duplex piston type.

One bilge pump, 6 by 4 by 6 inches, horizontal, duplex piston type.

One sanitary pump, 4½ by 3¾ by 4 inches, horizontal, duplex piston type.

The circulator was made by the Staten Island Shipbuilding Company, and is of the centrifugal type, with an 8-inch discharge, direct connected to a 6 by 6-inch engine. The condenser is independent of the engine, and consists of a cylindrical shell containing ¾-inch tubes, with a total cooling surface of 1,600 square feet. A 5 by 5½-inch Williamson combined steam and hand steering engine is located on the main deck under the pilot house. Besides a Hyde No. 3 windlass, there is a Hyde steam gypsy head, operated by an 8 by 8-inch double engine.

The vessel is lighted throughout by electricity, furnished by a 10-kilowatt General Electric generator, direct connected to a single-cylinder engine in the engine room. Besides about ninety-five incandescent lamps, there is an 18-inch Rushmore searchlight installed on top of the pilot house.

The main towing bitts are built of steel tubes about 18 inches in diameter, and extend through the main deck to the lower deck. These are exceptionally heavy in order that the boat may handle the largest tows.

After undergoing her trials successfully the boat was placed in commission, and has made one trip from New York to Norfolk to the complete satisfaction of her builders and owners.

STEAM WHISTLE TROUBLES.

BY DRAZIT.

From time to time we are called upon to face the problem of how to keep the whistle pipe clear of water; and so make that very important unit in a steamer's equipment as efficient

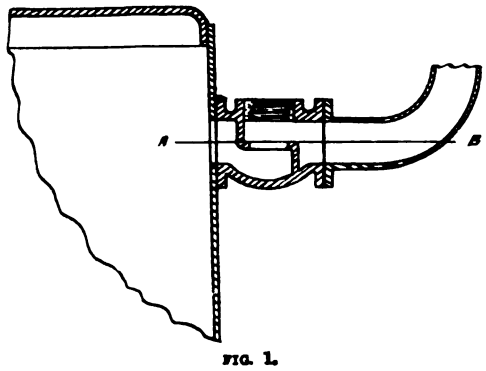


FIG. 1.

as every shipmaster has a right to have it. I suppose nearly all engineers have to deal with this problem at some time or other; and perhaps a few of my own experiences may be useful to some brother engineer who has not been able to solve the problem satisfactorily.

My first experience was in my first ship, and for some time after I joined her it was a case of stand clear when the whistle was blown. The cure was only effected by chance, through taking steam for the steering engine from the whistle pipe, instead of from the auxiliary pipe line, to allow winch steam to be shut off at sea. Since the ship was hard to steer,

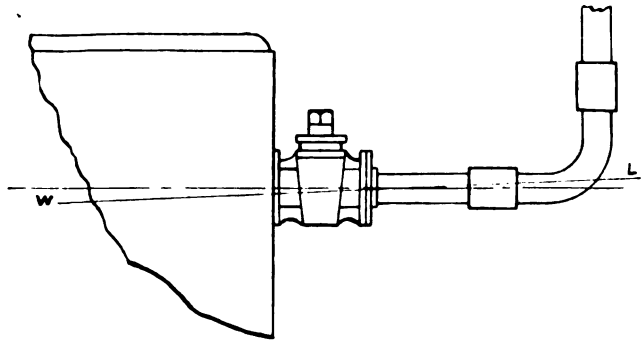


FIG. 2.

the steering engine was kept busy and it in its turn kept the whistle pipe dry.

Case No. 2 was to us a bit of a poser and caused a considerable amount of trouble before it was cured, since with two steamers having practically the same arrangement of piping, etc., one whistle worked with thoroughly dry steam, while the other did not. Both boilers have domes with the whistle pipe connected as shown in Fig. 1, with this difference: the dry-working whistle had a plain plug cock on the boiler end of the pipe, while the wet whistle had a valve; and a good

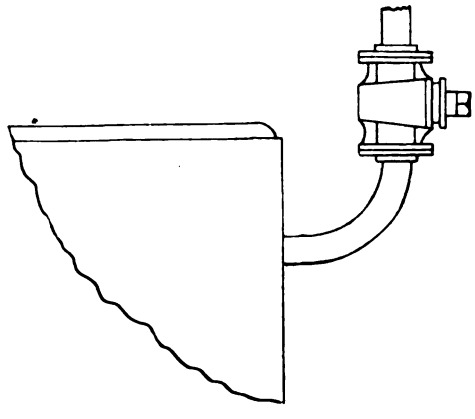


FIG. 3.

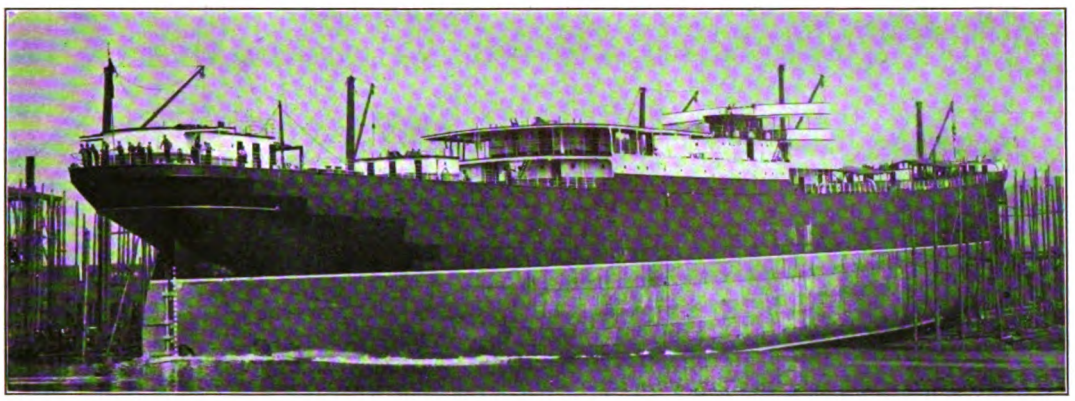
deal of experimenting was done before it was decided to try a cock instead of a valve on the wet whistle; and when to the relief of all concerned a cure was effected, we started to hunt round for the cause of the difference. We finally came to the conclusion that with the valve the water of condensation gradually accumulated until a water seal was formed on the line AB, in Fig. 1, the pipe afterwards gradually filling.

Case No. 3 was a very bad one also. The spindle of the valve was made some 3 feet in length, reaching through the top of the deckhouse, so that whistle steam could be shut off from the deck, but of course this did not stop the hot shower when it was necessary to give a blast. In this case also a cock was put on instead of a valve, and although a very great improvement was the result, it was noticed that a small quantity of water came with the first blow. On examination it was found that the horizontal piece of pipe had a dip in it at the

Generated on 2024-09-12 07:29 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

normal trim of the ship, as shown in Fig. 2; and when the bend was opened out and the whole coupled up, as shown in Fig. 3, a complete cure followed.

I do not think a patent drain at, say, midpoint between the whistle and boiler is of any use if the piping and valve on the boiler are not arranged so that water cannot lodge in them. They must drain into the boiler, and in this case the patent drain would not be required. My advice to any reader who has a troublesome whistle is, change your globe valve for a plug cock on the boiler end of the pipe, then see that your pipe has a good fall all the way from the whistle to the boiler, at the usual trim of your ship. With these conditions fulfilled, I think a cure will result.



LAUNCH OF THE OTAKI.

A NEW TYPE OF TURBINE STEAMER.

BY BENJAMIN TAYLOR.

The triple screw steamer *Otaki*, built by Messrs. William Denny & Bros., Dumbarton, for the New Zealand Shipping Company, Ltd., of London, is the first merchant vessel to be equipped with a combination of reciprocating and turbine engines. This arrangement of propelling machinery is not intended for high speeds, but to effect economy in the operation of slow-speed cargo steamships. The idea of securing economy in medium-speed vessels by combining the reciprocating engine with the turbine engine, is the conception of the Hon. C. A. Parsons, of the Parsons Marine Steam Turbine Company, Ltd. The only previous vessel of this type was the destroyer *Velox*, in which reciprocating engines were fitted at the forward end of the turbines, to be connected up when low speed was desired. In the case of the *Otaki*, two sets of reciprocating engines, with cylinders 24½, 39 and 58 inches diameter and a stroke of 39 inches, have been installed, driving the wing screws as in ordinary twin-screw vessels. Between these engines a large-sized low-pressure turbine has been placed, connected to the center screw. The steam is passed first through the reciprocating engines, and then goes to the low-pressure turbine, where the expansion is completed. By this arrangement the high-pressure steam is used in reciprocating engines and low-pressure steam only in the turbine.

The turbine revolves only in one direction, and can, therefore, be used for propulsion only when the vessel is going ahead. Change valves are fitted so that the steam may be passed either directly from the reciprocating engines into the condenser, or to the low-pressure turbine. Thus in maneuvering the vessel becomes an ordinary twin-screw steamer.

The *Otaki* is 464 feet 6 inches long with a breadth of 60 feet and a depth of 34 feet. She is primarily intended for the frozen meat trade from New Zealand, and for this purpose the entire forward part of the vessel in the holds and lower 'tween decks is insulated. One of the 'tween deck spaces is divided into sections and refrigerated by brine pipes, which, under control, enable variations of temperature to be obtained suitable to various classes of perishable cargo. The remainder of the insulated space is cooled by air driven through coil rooms, which are kept at a low temperature by the expansion of compressed ammonia in pipes attached to the bulkheads.

The vessel has five cargo hatchways, each fitted with powerful cargo gear with a great outreach over the ship's side, so that cargo can be discharged direct into the trucks without intermediate handling on the deck. A large steel derrick is fitted at one of the hatches, so that heavy weights can be handled without the necessity of bringing the ship alongside large cranes on shore.

Although not intended primarily for passenger service, the *Otaki* has a Board of Trade passenger certificate, and a few roomy and well-ventilated cabins have been provided for passengers. These accommodations, together with those for the superior officers, are situated on the bridge deck, while those for the junior officers are situated on the deck below.

The *Otaki* is an exact replica of two ships now in service for the New Zealand Shipping Company, Ltd., with the exception of the propelling machinery. Comparing the results obtained on trials of her sister ship, the *Orari*, under similar conditions, an average speed of 15.02 knots was obtained with the *Otaki*, as against 14.6 knots for the *Orari*. At a subsequent trial, the *Otaki* obtained a speed of 15.09 knots. As the boiler installation is precisely the same in both ships, it is considered that this performance demonstrates the advantage of the combined reciprocating and turbine machinery over reciprocating engines.

Based on the results of the trial trips, the speed of the *Otaki* is virtually half a knot greater than that of her two sister ships, and this increased speed is obtained on lower water consumption, which means a correspondingly lower coal consumption. Horsepower in the combined form of machinery is not a very satisfactory measure of useful work, but, assuming that her sister ships had been driven at the same speed on trial as the *Otaki*, and basing the results on the indicated horsepower resulting from this and applying the horsepower to the *Otaki* for her trial trip speed, then the water per horsepower for all purposes would figure out as 12.3 pounds. This result, of course, must be accepted with a certain amount of reserve, as it is based only on the trial data of one of the vessels. Confirmation of this result can only be obtained from actual service on the regular 13,000-mile route of these ships.

The economy of the *Otaki* is due partly to the type of condenser fitted, which enables a high vacuum to be steadily maintained. This condenser is of the "Contraflo" type, from designs by Mr. D. B. Morrison.

Generated on 2024-09-12 07:31 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

A New Reversing Motor for Launches and Yachts.*

The question of reversing internal combustion motors became prominent at the same moment as the application of this type of engine began to be considered for the propulsion of ships, and the problem being particularly fascinating to a number of inventors, has naturally been the source of various patents. The greater part of these inventions have stopped on paper, and those that have taken a more material shape have generally turned out practically inexpedient. Meanwhile boat builders have had to be contented with non-reversible motors provided with different kinds of gearing between the crank shaft and propeller shaft, or with adjustable blades on

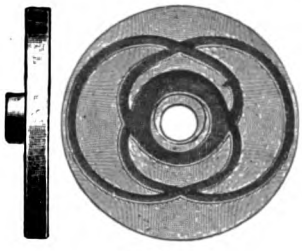


FIG. 1.

the propeller; in the last-named case the propeller shaft itself being non-reversible. We need hardly point out the many difficulties and disadvantages that are inseparable from these methods of solving the reversing problem.

In 1902, Mr. F. G. Ericsson, connected with a small mechanical workshop in Stockholm, patented a direct-reversible motor that attracted much attention. The engine was provided with only one cylinder, designed according to the four-cycle system, to work with gasoline or benzine. The exhaust valve alone was positively governed, and the air inlet-valve opened automatically during the suction stroke, owing to the vacuum that was produced behind the piston. The reversing of this motor was accomplished by igniting the combustible mixture of air and oil-gas at an early stage of the compressing stroke;

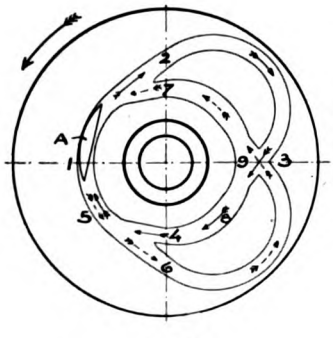


FIG. 2.

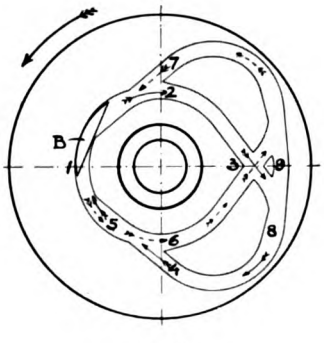


FIG. 3.

the exhaust valve being governed for running the engine "ahead" or "astern" by the aid of a grooved disc keyed to the crank shaft (see Fig. 1). The grooves in this disc guided the movements of a sliding nut attached to the end of a lever that opened the exhaust valve at every other stroke of the piston. Motors provided with this arrangement ran very well, but as they could be built with only one cylinder, much remained to be improved upon in order to obtain an engine for high power.

In 1905 the patents were turned over to a new company, *"Motoraktiebolaget Reversator,"* which resolved to apply the invention to multiple-cylinder motors of the latest design, capable of developing sufficient power for high-speed motor boats and yachts.

Up to date ten different sizes of the "Reversator" motor have been designed and built for utilizing benzine, gasoline or alcohol, varying in power from 3 to 90-brake horsepower, and provided with as many as six cylinders. The new designs are based upon newly-invented improvements on the guiding of the inlet valves as well as of the exhaust valves. The grooved guiding discs are now of a simplified design, and keyed to a separate operating shaft, rotating at half the number of revolutions of the crank shaft.

The improved guiding discs are illustrated in Figs. 2 and 3; Fig. 2 showing the disc belonging to exhaust and Fig. 3 that

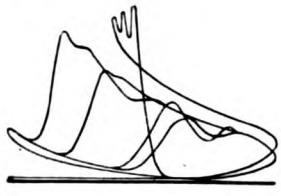


FIG. 4.

belonging to the inlet valve. *A* and *B* represent the sliding pieces pressed against the outer edge of the grooves by means of springs. A revolution of these discs through 90 degrees represents one full stroke of the piston, or half a revolution of the crank shaft.

Supposing the engine to be running "ahead," and the discs to be revolving in the direction of the large arrows in Figs. 2 and 3, the sliding pieces *A* and *B* must follow the grooves along the paths denoted by the full-drawn small arrows. Ignition, combustion and expansion take place from 1 to 2, exhaust of combustion gases from 2 to 3, entrance of fresh air into the cylinder from 3 to 4, compression from 4 to 1, after

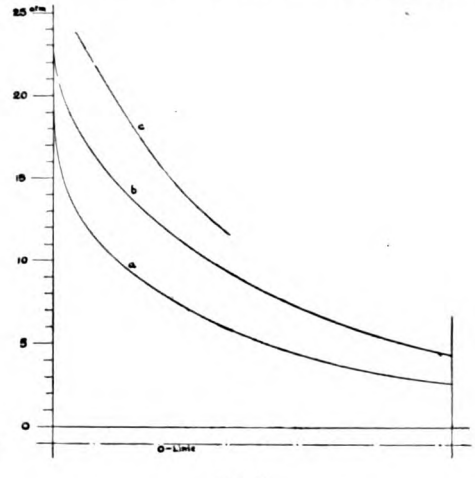


FIG. 5.

which the cycle is repeated in the same order. Now, suppose the direction of revolution to be reversed, which is accomplished by igniting the combustible contents in the cylinder at an early stage during the compressing stroke. The sliding pieces *A* and *B* will at the moment, when reversing commences, be in the position marked 5, and from thence follow the path denoted by the small dotted arrows. Expansion will, under these circumstances, be executed from 5 to 6, exhaust from 6 to 3, entrance of fresh air from 3 to 7, compression from 7 to 1, and ignition followed by combustion and expansion from 1 to 6.

Now, considering the case of a four-cylinder motor, we find that at the moment of reversing, the entrance of fresh air has

* Compiled principally from "Teknisk Tidskrift," journal of the Swedish Society of Engineers and Architects. Supplementary material and illustrations supplied by "Motoraktiebolaget Reversator," Stockholm, Sweden.

Generated on 2024-09-12 07:32 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

just commenced in one of the cylinders, and the sliding pieces controlling the valves of this cylinder are consequently near the position marked 8 in Figs. 2 and 3. After reversing has commenced the sliding pieces will follow the paths 8-9-7, which causes the cycles in this cylinder immediately to become executed in proper order. This is a very important point in the new improvement, and explains why the guiding disc projecting at the bottom of the dial, for the purpose of regulating the speed of the motor. This regulation is accomplished by throttling the admission of combustible gas mixture to the cylinder through the aid of a slender wire connected to the maneuvering pedestal, which, consequently, may be fixed in any convenient place in the boat independently of the position of the motor.

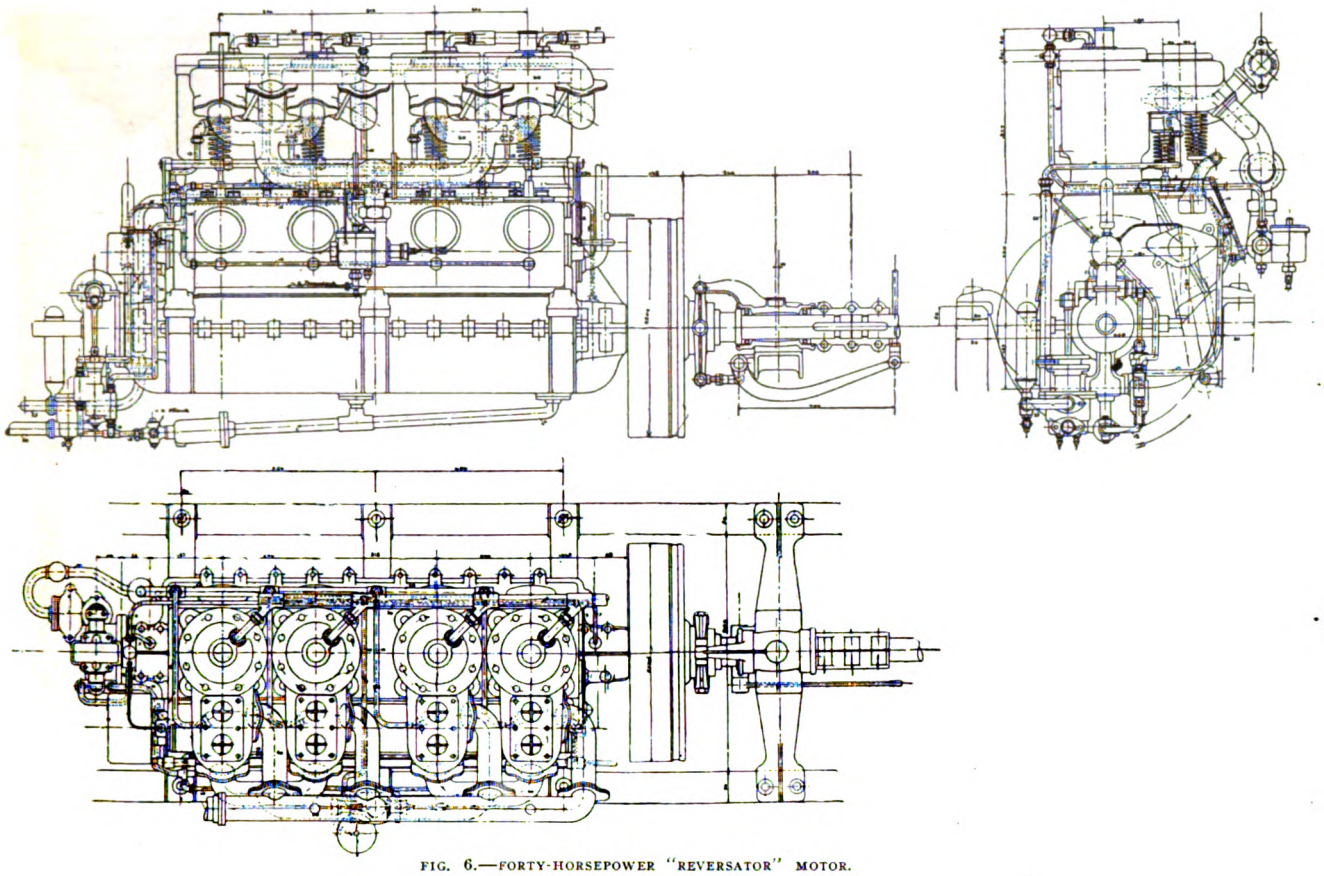


FIG. 6.—FORTY-HORSEPOWER "REVERSATOR" MOTOR.

originally patented by Mr. F. G Ericsson cannot be employed in multiple-cylinder motors.

In order to explain fully the process of reversing we must add a few words regarding the arrangements for ignition. The inflammable gas mixture is ignited in the ordinary manner by the aid of an electric spark, produced either from a battery alone or from a battery in combination with a magnetic inductor. The contact is formed and broken by a fixture keyed to the operating shaft, in such a manner as to allow of its position being altered while the motor is running. This alteration, which causes a varying timing of the ignition, is accomplished simply by turning a small lever on the maneuvering dial.

The maneuvering dial is generally fixed to a pedestal carrying the steering wheel of the boat in addition to a small lever

To cause the motor to develop its highest efficiency, the ignition must occur just a moment before the piston has arrived at the upper end of its compressing stroke. If at the same time the motor is to run "ahead," the maneuvering lever must be locked in position at "full"; the lever being removed from this position to a position marked "ahead" alters the ignition, so that it occurs later; *i. e.*, after the piston has traveled part of its downward expansion stroke. The combustion pressure and the speed of the motor are thus reduced, until a convenient speed for reversing is obtained. The lever is now moved past the position marked "stop," at which the ignition becomes suspended, and over to "astern"; a proceeding which causes ignition to occur when the piston has completed only a part of its upward compressing stroke. Now

FIG. 7.—OPEN LAUNCH "TIRFING."

Generated on 2024-09-12 07:36 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

combustion takes place, and the pressure above the piston rises suddenly to 80 or 90 percent above the pressure indicated by the ordinary expansion curve, as shown in the diagram (Fig. 4). The counter pressure thus thrown on the piston surmounts the momentum of the moving parts of the engine, and the crank is thrown back in the opposite direction to that in which it was just moving.

The motor having started to run "astern," continues to do so at reduced speed, as the ignition does not occur until the piston has traveled a considerable part of its downward expansion stroke. By removing the maneuvering lever from "astern" to "full," and locking it in this position, the ignition is timed to occur just before the piston has concluded its compression stroke, thus causing the motor to develop full power astern with the same number of revolutions as when working full power ahead. Reversing from astern to ahead is accomplished in a similar manner to that just described. The motor performs these maneuvers without shocks or extra vibrations; in fact, the reversing is hardly noticeable to a passenger turning his back to the operator, even in the case of lightly-built racing boats.

The considerable rise of pressure during the reversing stroke (see Fig. 4) is rather astonishing, but may easily be explained by taking into account several circumstances connected with the slowing down of the motor just before reversing; *i. e.*, a more complete admission of combustible gas than when running at full speed and reduced loss from leakage and cooling.

The curves shown in Fig. 5 are worked out from a number of diagrams, obtained from a Reversator motor with only one cylinder, provided with an air-inlet valve, operated automatically by the vacuum produced during the suction stroke. *a* represents the ordinary expansion curve; *b* is a curve connecting the points of maximum pressure indicated at different grades of belated ignition, and *c* is a curve connecting the points indicating combustion pressure when reversing at various positions of the piston in its compressing stroke.

In Fig. 4 are reproduced some diagrams actually obtained from the above-named motor just before and after the reversing moment. Those diagrams show plainly how the ignition takes place later and later on during the expansion stroke, owing to the displacement of the maneuvering lever. Finally, the ignition is caused to occur during the compression stroke, and the piston is reversed after having traveled nearly two-thirds of this stroke. The wavy shape of the expansion curve in these diagrams is attributed to vibrations in the pressure spring of the indicator, caused by the explosions.

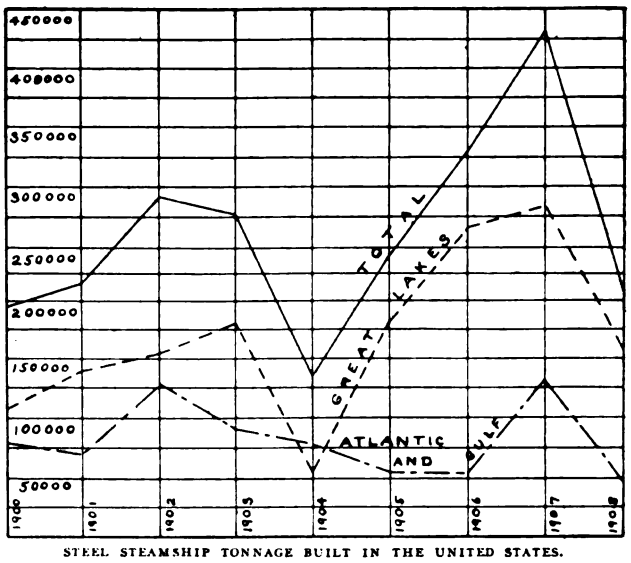
A few words may be added relating to the method employed for starting the motor. The combustible gas mixture is first drawn into the cylinder either by means of a vacuum pump or by turning the crank shaft around a few revolutions; a special arrangement being provided for avoiding compression during this operation. Ignition is also prevented by fixing the maneuvering lever at "stop." When the cylinder has become loaded the lever is moved to "ahead" or "astern," which causes ignition, and the motor starts running. The starting is quite an easy matter, and involves no risk whatever. Multiple-cylinder motors may be started simply by turning the maneuvering lever to "ahead" or "astern," provided that the motor has just recently been running.

G. O. M. OLSSON.

Shipbuilding in the United States.

Although reports from the Bureau of Navigation of the Department of Commerce and Labor showed a record year in shipbuilding for the fiscal year 1908, the record for the calendar year 1908 is an entirely different story. From Dec. 31, 1907, to Dec. 31, 1908, 1,112 merchant vessels, aggregating 287,603 gross tons, were built and numbered in the United States. This, as compared with 1,056 ships of 502,508 gross tons of the previous year, shows a loss of 42 percent. Also the average tonnage is less than that for any period during the last nine years with the exception of the year 1904.

Since the fiscal year 1908, ended June 30, it will be seen that almost the entire depression has come during the last six months. Furthermore, it is accounted for principally by the great decrease in steel steamship tonnage being built on the



STEEL STEAMSHIP TONNAGE BUILT IN THE UNITED STATES.

Great Lakes. This work has been practically at a standstill during the past six months; for 98 percent of the steel steamship construction on the Great Lakes, which comprises 73 percent of the total steam tonnage built in the country during the year, was constructed during the first six months of the year.

The tonnage of sailing vessels has increased 19 percent over that for 1907, and apparently this part of the shipbuilding industry has not been unusually affected during the past six months.

MERCHANT VESSELS BUILT IN THE UNITED STATES.

YEAR.	Ships.	Gross Tons.	Average Tons.	GREAT LAKES SHIPS.		
				Gross Tons.	Per Cent.	Average.
1900	1,102	365,791	332	129,973	35.6	1,476
1901	1,322	376,129	284	156,157	41.5	1,270
1902	1,270	434,005	342	158,230	36.5	1,521
1903	1,159	381,970	330	182,593	47.8	1,438
1904	1,063	265,104	249	54,042	20.4	819
1905	1,054	306,563	291	182,361	59.5	1,736
1906	1,045	393,291	376	268,085	68.2	2,197
1907	1,056	502,508	476	283,492	56.4	2,100
1908	1,112	287,603	259	157,672	54.8	1,168

STEEL STEAMERS BUILT IN THE UNITED STATES.

SIX MONTHS ENDING	TOTALS.		ATLANTIC AND GULF.		GREAT LAKES.	
	Ships.	Gross Tons.	Ships.	Gross Tons.	Ships.	Gross Tons.
June 30, 1900	52	105,713	31	34,803	17	63,885
Dec. 31, 1900	40	91,244	20	44,179	16	44,626
June 30, 1901	64	144,021	31	46,297	30	91,994
Dec. 31, 1901	40	74,604	21	25,541	17	49,020
June 30, 1902	74	196,197	34	76,186	32	109,019
Dec. 31, 1902	42	98,516	26	52,385	12	43,248
June 30, 1903	69	153,389	33	54,411	29	88,412
Dec. 31, 1903	50	126,392	20	36,077	28	89,562
June 30, 1904	43	113,261	27	61,904	13	50,336
Dec. 31, 1904	31	19,472	25	16,955	5	2,498
June 30, 1905	42	139,883	17	39,822	24	99,999
Dec. 31, 1905	51	100,127	27	18,843	21	80,932
June 30, 1906	58	181,614	25	24,378	31	156,792
Dec. 31, 1906	56	146,177	33	35,895	21	109,471
June 30, 1907	66	214,488	38	75,564	26	129,242
Dec. 31, 1907	69	216,181	34	53,167	31	151,272
June 30, 1908	72	200,923	18	34,144	44	153,107
Dec. 31, 1908	26	13,503	13	10,369	10	2,987

Generated on 2024-09-12 07:29 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

ADAPTABILITY OF PRODUCER GAS FOR MARINE WORK.*

BY E. SHACKLETON, A. M. I. MECH. E.

Notwithstanding the fact that the producer gas plant is the prime mover in the shops of many shipbuilders, both shipbuilders and marine engineers seem to be exceedingly chary of giving a trial to the gas engine in boats they build or engine. It is natural that after their intimate acquaintance with the steam engine and its traditions, which, in many cases, dates from over half a century back, they should be very reluctant to adopt a new type of prime mover which but a few years ago was regarded as only suitable for operating light printing machinery where the power required did not exceed 10 horsepower. The natural opposition of the steam-engine builder to anything in the nature of a gas engine was, up to a few years ago, very acute, and to-day in many cases it still exists. However, the economic law must eventually prevail, and, by reason of severe competition, ship owners will be driven in the near future to ask from the builders a type of boat which can be operated more cheaply as far as fuel consumption is concerned, particularly in the case of cargo vessels from 4,000 to 5,000 tons gross.

The present type of steam engine employed is no doubt very economical as far as steam goes with a coal consumption under favorable circumstances of slightly over 1 pound per indicated horsepower per hour. More common figures for coal consumption, however, are from 1¾ to 2 pounds per indicated horsepower per hour. Even if superheated steam is employed, with its attendant wear and tear, it is questionable whether a consumption of 1 pound per indicated horsepower per hour can be maintained.

The only substitutes now available for the steam engine in marine work are the oil engine and the gas engine. The gas engine and producer plant appear to be more directly suited to marine requirements than a large oil engine, notwithstanding the extra inducement which the latter offers as being self-contained. It is, however, very questionable whether the problem of dealing with every description of crude oil as a fuel in an oil engine has been definitely solved, and, even in such event, it is very doubtful if there is any real advantage over the producer plant in power cost. It must also be borne in mind that the most suitable type of engine for operation with crude oil is somewhat complicated and expensive to build.

The writer offers the following scheme as a possible solution of the problem for cargo vessels of from 4,000 to 5,000 tons gross: For fuel, producer gas, generated in a plant of the suction type such as are now in successful operation on land; for prime movers, a vertical tandem inclosed gas engine of 700 brake horsepower with two secondary sets of crank chamber gas engines each of 250 brake horsepower. Each of these three engines to be coupled to a dynamo supplying power to two motors on the propeller shafts either of 400 or 500 kilowatt capacity, together with the usual main switchboard and accessories. The steering gear would be operated by an electric motor of suitable design and power. The usual pumps, of the centrifugal type in this case, would also be operated by electric motors, namely, the bilge, ballast and circulating pumps, the latter being employed for the cooling water of the gas engines. A small oil engine of, say, 6 brake horsepower would be used for lighting the ship when in port. Without attempting to go into smaller details, which, of course, are impossible to specify correctly until the dimensions, space and conditions of a ship so fitted can be definitely decided on by the shipbuilders, it will be seen that this equipment calls for nothing which is not now in the market; in other words, it is a commercial possibility.

* Read before the Institute of Marine Engineers, London, December, 1908.

The cost of repairs for a plant of this type varies somewhat, but the following may be taken as approximately correct:

	Per annum.
For 100 horsepower, about £4	$19.47
For 200 horsepower, about 6	29.20
For 300 horsepower, about 9	43.80
For 400 horsepower, about 12	58.40
For 500 horsepower, about 15	73.00

The cost of cleaning and repairing the boilers used for a steam plant of similar size is much more serious.

On a suction producer gas engine of 360 brake horsepower, running at 200 revolutions per minute, the cylinders should have liners of special hard close-grained cast iron, which may be easily re-bored when worn. A space between the liner and outside of the cylinder forms the water jacket which keeps the cylinder cool by means of a constant circulation of water. The piston should be of the bucket type made of hard close-grained cast iron fitted with metallic piston rings and coupled to the connecting rod by means of a hardened and ground piston pin. The engine bed should be a massive hollow casting, which, in the case of a horizontal engine, is prolonged under the cylinder to reduce the overhang to a minimum. This improvement prevents vibration and the working loose of the engine on its foundation, which so often occurs with engines having long overhanging cylinders. The crank shaft should be of Siemens-Martin steel forged from the solid and running in adjustable white metal bearings having ample wearing surface, intermediate bearings to be fitted between each crank. The flywheel should be of extra weight in order to insure steady running and should be 8 feet in diameter by 15 inches wide on the face.

A sensitive governor of improved construction should be provided, and so arranged that changes in speed can be made without stopping the engine, the governor controlling automatically the amount of gas consumed according to the work done at any period. Independent magneto-ignition with a time adjustment should be fitted. The air and gas valves should be fitted into loose cast iron boxes or valve plugs, which can be easily removed for cleaning and repairs. The joint between the valve plugs and the cylinder should be a ground metal-to-metal joint. The valves themselves and the covers should be hollow and water-cooled. The piston, crank pin, main bearings and all moving parts should be lubricated and forced lubrication should be used for the cylinder crank shaft and connecting rod bearings and exhaust cam shaft, with ring lubrication to the inlet cam shaft. The gas gag should be of cast iron with a rubber diaphragm.

Reversing is beyond a doubt a most important function in marine work, and it must be an operation that can be carried out with certainty and without delay. To reverse a gas engine of any size would, and will be, an extremely complicated process. While it is recognized that a reversible gas engine is an accomplished fact, it is probable that under the very onerous conditions of marine work the increased wear and tear and complication of the reversing mechanism would result in a sacrifice of efficiency and reliability. With the electric drive proposed, the reversing process is, of course, easily carried out by means of the motors attached to the propeller shaft.

Although the writer advocates electric drive, it is clear that to shipowners who do not require more than 600 or 800 brake horsepower the expense of this type of drive would probably deter them from building a steamer fitted with a gas engine. There are, however, on the market several reversing friction clutches which could possibly in a modified form do all that is expected if the full power were not desired for going astern. There is no reason to suppose that they would not perform their duties satisfactorily. Where twin screws are employed,

Generated on 2024-09-12 07:39 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

reversing may be confined to one propeller, which, under all ordinary routine conditions, should prove satisfactory, although being somewhat slower in action. In such a case as this, the proposal submitted as to electrically-driven winches would still be carried out, except in the case of a sailing vessel. One concern now constructs reversing gears in sizes up to 2,500 horsepower, and it has made several gears of large sizes suitable for marine work. In these clutches the gear is always in mesh; consequently the clutch is perfectly silent when running ahead and almost noiseless when going astern. It has one positive speed ahead and astern. When desirable the speed can be regulated and the boat slowed down by manipulating the starting gear.

The inclosed type of gas engine recommended for consideration in this scheme appears to be admirably adapted for marine conditions. This type is well balanced, positively lubricated and, being inclosed, any leakage of gas that might pass the pistons is confined to the case. Its speed is higher than certain types of gas engines, but at such speeds gas engines of the type referred to run, as a rule, steadily without great vibration. It is not anticipated that the sole plate or bed foundation would present serious difficulties to the shipbuilder. The system of governing these engines compared with steam engines is a decided advantage, as there is no hit and miss, but positive throttling by varying the quantity and quality of explosive mixture. Engines of the tandem type have also proved themselves to be very reliable and admirably adapted for this class of work.

For the purpose of starting these engines, that is, charging the compressed air reservoirs, it is proposed to use the small oil engine which is also used for ship lighting. It is not intended for the limited power required for a 3,000 and 4,000-ton gross gas-driven ship to introduce the bituminous producer. While it is recognized that such a producer would undoubtedly be of great advantage for marine purposes, the writer feels satisfied that anthracite is now sufficiently available to economically answer all the requirements of a cargo boat running on a fast route. This fuel is available outside Wales, in America, New Zealand and various parts of the Continent. Even if it were not available, recourse could be made to good coke. As far as can be seen, it is, moreover, questionable whether for powers not exceeding 2,000 brake horsepower the bituminous plant would really be such an advantage as would otherwise appear. Outside its main feature, the ability to use common fuel, it is cumbersome, decidedly more complicated in its action, requires considerably more attention, and is almost twice as heavy as the suction gas plant. Ammonia recovery would also be out of the question on shipboard. While it is recognized that the ability to use a common fuel is certainly a great advantage, it appears to the author that the simplicity of the suction plant will in the long run outweigh such advantages for moderate powers under marine conditions.

In making comparative tables of cost of a gas-driven and a steam-driven ship the writer has in mind that anthracite is more expensive than Welsh steam coal, and also than North Country coal, but, taking into consideration the pros and cons, this is an all-important feature. It would doubtless be necessary, however, to use a bituminous producer plant for powers exceeding 2,000 brake horsepower.

The fairly regular load in marine work would suit a producer plant, and the fact that such plants would be worked continuously is favorable to the producer. In fact, a more uniform gas of even quantity is likely to be produced with corresponding fuel efficiency than would be the case where the plant is shut down at the end of the day. The bogey of door troubles, etc., is very much over-estimated and under the intelligent eye of the average marine engineer little or no trouble should arise from this source. It is proposed to have the generators in four small units, so that in the event of any repair or cleaning one may be shut down till this has been effected without interference with the production of gas from the rest of the plant. When anthracite is not available, good gas coke, which can be obtained almost anywhere, may be used with good results on a slightly higher fuel consumption. Coke, however, requires more attention at the generator, and the gas made from it is not so clean as that made from anthracite. Scrubbers should be made extra large, and sea water should not be used for direct use in the gas plant, as the vaporizer would quickly become incrusted with salt and cease to make steam.

Objection will no doubt be made to the proposed speed of the propellers, as 250 or 300 revolutions per minute is, of course, much higher than is used in the present cargo boat. While it is recognized that a low-speed propeller has certain advantages, it must be borne in mind that they are more or less in ratio to the present steam-engine speed, which could not well be higher. The writer is of the opinion that where a high-speed propeller will be found necessary the shipbuilder will quickly adapt himself to the exigencies of the position. The electric motors for driving the two propellers would of necessity occupy more space near the propellers than the present tunnel permits, but this is also a matter which the shipbuilder could allow for without any serious expenditure when the boat was being built.

Doubtless the cost of the electrical equipment which has been outlined would be heavier than the average steam plant by about £6,000 or £7,000 ($30,000 or $35,000), but apart from the huge saving in fuel consumption for the steamer, the reduction of strain on the hull, due to a short shaft at the propeller end, and the electrical drive, together with the great advantage that in bad weather a very effective method is offered to prevent racing, would be invaluable. Another objection to the electrical drive may be urged on account of the loss of power from the dynamo to the motor. This would probably be about 15 percent and is no doubt an item of some importance, but let it be considered that, while electrical losses are a measured quantity, frictional losses from the present system of drive are bound to be fairly high, probably 10 or 12 percent, and are practically unmeasured quantities.

One very strong feature of the scheme under consideration would be the arrangement for electrically-operated winches, one of the smaller units in the engine room driving a dynamo for the purpose of discharging cargo. Undoubtedly the fittest place for any power generation is the engine room, instead of the present system of ten or more scattered steam winches.

Sea water would be used for the scrubbers attached to the gas producer and also in the engine jackets. It is not likely that sea water would cause any trouble in the engine jackets, since large volumes of water are circulated and the water is not allowed to boil there.

Although, in view of the high efficiency of the electric motor, troubles are now of quite rare occurrence with well designed machines, provision ought to be made for even such remote contingencies as the burning out or fusing of the motor. It is suggested that this should be accomplished by the addition of a propeller on an emergency shaft, the same being directly in line with one of the power units, so that in the event of the tunnel becoming flooded or the motor rendered useless from other causes, the shaft could be brought into operation and slow speed maintained for some time through the direct drive from the engine

The small oil engine previously mentioned performs a double purpose. It might frequently happen that when a cargo boat is in port there would be periods when light is desired for use on the ship, for which it would be obviously uneconomical to run one of the smaller gas units. The small oil engine could supply power for sixty 16-candle-power lamps.

Generated on 2024-09-12 07:32 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

As to the type of boat where gas engines could be employed as an auxiliary method of propulsion, the writer is of the opinion that the installation of a 400 or 500 brake horsepower gas-driven plant could be adapted to large modern sailing vessels, in which case, of course, the use of one or two propellers would be recommended. There is every reason to believe that such an arrangement would prove exceedingly economical. The engines could be stopped when full sail was available and the speed could be considerably increased with very light winds. Of course there would be a slight reduction in the cargo space available, and also a skilled engineer would have to be carried, but the increased speed would doubtless prove a sufficient inducement to shippers who desire reasonable time voyages. With a boat of, say, 2,000 tons gross, from 5 to 6 knots under power alone would be feasible in moderate weather.

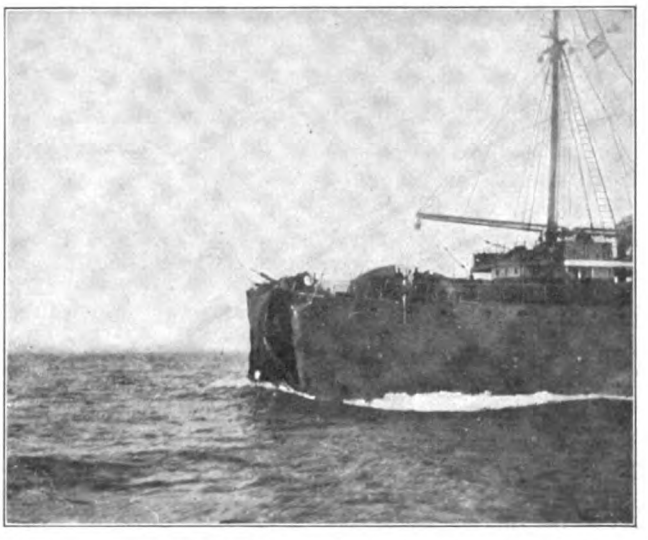
A DISASTROUS COLLISION.

Early Saturday morning, Jan. 23, the White Star Liner *Republic,* bound from New York to the Mediterranean, collided with the *Florida* of the Lloyd Italiano Line, bound from Naples to New York. The collision occurred off Nantucket, after the *Republic* had proceeded 193 miles from Sandy Hook. The weather was foggy, and both ships were proceeding under reduced speed. The *Florida* struck the *Republic* on the port side, tearing a large hole both above and below the waterline in the engine-room space. The bow of the *Florida* was demolished, and the two forward compartments immediately filled with water. The collision bulkhead, however, prevented any further damage to the vessel, and she was able to proceed under her own steam to New York.

The engine room of the *Republic* was almost immediately flooded, there being only time for the engine-room staff to close the watertight doors in the engine-room bulkheads before making their escape. Through the failure of the after watertight bulkheads, the after part of the vessel was gradually flooded, and after remaining afloat forty and one-half hours she sank in 45 fathoms of water.

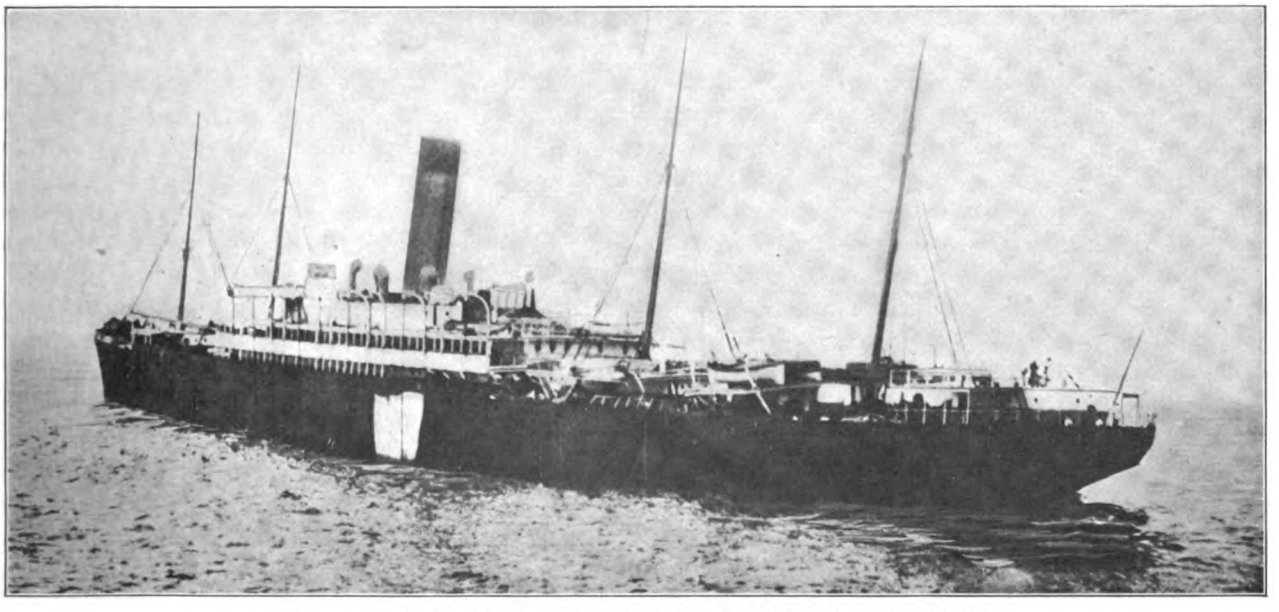
Seven lives were lost and three were injured, the loss of life being due entirely to the effects of the collision. The rest of the passengers and the crew were safely transferred from the *Republic* to the *Florida,* and finally to the White Star Liner *Baltic,* on which they were brought to New York.

The *Republic* was a steel, twin-screw steamship of 15,378 gross tons. Her dimensions were: Length, 570 feet; breadth, 67.8 feet; depth, 24 feet. Her propelling machinery consisted of two four-cylinder quadruple-expansion engines, with cylinders 29, 41½, 61 and 87 inches diameter by 60 inches stroke, the nominal horsepower being 1,180. She was built in 1903 by Harland & Wolff, Ltd., at Belfast. The *Florida* is a steel, twin-screw steamship of 3,231 gross tons, built in 1905 at Genoa, Italy, by the Soc. Esercizio Bocini. She is 381.4 feet long, 48.1 feet beam, with a depth of 25.7 feet. She is driven by two three-cylinder triple-expansion engines capable of developing a nominal horsepower of 444. The cylinder diameters are 21, 33, 59 inches, with a stroke of 39 inches.



DAMAGED BOW OF THE FLORIDA. (PHOTO FROM N. Y. HERALD.)

This accident demonstrates clearly the status of watertight bulkheads as at present arranged in passenger and cargo steamships as a means of keeping a damaged ship afloat. The engine room of the *Republic* was only about 50 feet long; and if the after-bulkheads had held, the loss of buoyancy due to flooding the engine room alone would not have resulted in the loss of the ship, although she was rendered helpless by the submerging of her pumps and engines. The gradual flooding of the after-holds seems to show that the bulkheads were not only not watertight, but not strong enough to withstand the pressure of the water.



VIEW OF THE REPUBLIC SHORTLY AFTER THE COLLISION. (PHOTO FROM N. Y. HERALD.)

Generated on 2024-09-12 07:31 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

INTERNATIONAL MARINE ENGINEERING

Published Monthly at
17 Battery Place New York
By MARINE ENGINEERING, INCORPORATED
H. L. ALDRICH, President and Treasurer
GEORGE SLATE, Vice-President
E. L. SUMNER, Secretary
and at
Christopher St., Finsbury Square, London, E. C.
E. J. P. BENN, Director and Publisher

HOWARD H. BROWN, Editor

Branch Offices { Philadelphia, Machinery Dept., The Bourse, S. W. ANNESS.
Boston, 170 Summer St., S. I. CARPENTER.

Entered at New York Post Office as second-class matter.
Copyright, 1909, by Marine Engineering, Inc., New York.
INTERNATIONAL MARINE ENGINEERING is registered in the United States Patent Office.
Copyright in Great Britain, entered at Stationers' Hall, London.

The edition of this issue comprises 6,000 copies. We have no free list and accept no return copies.

Notice to Advertisers.

Changes to be made in copy, or in orders for advertising, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following. If proof is to be submitted, copy must be in our hands not later than the 10th of the month.

The Possibility of Gas Propulsion.

With the most efficient type of steam plant now used for marine work only 10 or 11 percent of the total heat value of the coal consumed is realized in actual work at the propeller shaft. Although a coal consumption as low as 1 pound per indicated horsepower per hour can be obtained with reciprocating engines under the best of conditions, yet this is not usual. Under average service conditions a consumption of 1½ pounds per indicated horsepower per hour is considered a very good performance, while an average value would probably be much nearer 2 pounds per indicated horsepower per hour. On her official trials the latest United States battleship, which is fitted with watertube boilers and reciprocating engines, showed a coal consumption of 1.74 pounds per indicated horsepower per hour, which would be equivalent to about 1.98 pounds per brake horsepower per hour, assuming the brake horsepower to be about 88 percent of the indicated horsepower. The *Lusitania*, with Scotch boilers and turbine engines, consumed on trial 1.43 pounds of coal per brake horsepower per hour, while an average value of 1.8 pounds per indicated horsepower per hour is the result of records covering a large number of steamships of various types operating on the Great Lakes of North America, where refinement in steam plant design is carried to extremes.

Experience on shore with gas engines operating on producer gas has shown that this type of prime mover is capable of developing a brake horsepower on 1 pound of coal or less per hour. About 17 percent of the heat value of the coal consumed is turned into useful work at the engine shaft, or nearly twice as much as can be obtained from a steam plant with reciprocating engines and about one and one-half times as much as can be obtained from a steam plant with turbines. Furthermore, the sum of the two principal heat losses in a steam plant—that is the stack and condenser losses—is nearly equal to the sum of the two most important heat losses in a gas plant, namely: the jacket and exhaust losses; but whereas there is little prospect of utilizing the heat thus lost in a steam plant, there is a possibility of utilizing at least a portion of that loss in a gas plant. It is inevitable that a form of power plant which theoretically offers such marked increase in economy of fuel consumption, shall sooner or later be developed in a practical way, and the past year has marked a substantial beginning in the development of the marine gas power plant. The first ship of any size and importance in the United States to be equipped with such a plant is described in our leading article this month.

At the present time the gas producer seems to have attained a more satisfactory development for marine work than has the gas engine, at least for large power. For reasons of simplicity, utility and safety, the suction type of producer has been advanced as the most suitable for marine work. It is obvious that a successful marine gas producer must be capable of using bituminous coal, and the great weight and large floor space required for most stationary bituminous suction producers have led many to believe that it could not compete successfully with steam boilers. It is true that on shore about two-thirds of the suction gas producer plants in operation in the United States use anthracite coal, while charcoal is used in a few cases, but it was pointed out by Mr. R. E. Fernald, of the U. S. Geological Survey Fuel Testing Corps, in a paper presented before the May meeting of the Western Society of Engineers, that although bituminous coal is used in only approximately one-third of the total number of suction producer plants, nevertheless this third probably covers in the neighborhood of from 65 to 75 percent of the aggregate horsepower in use, so that successful bituminous suction producers are an accomplished fact.

The type of plant used on shore is manifestly unsuited for marine work, because it weighs as a general rule over 200 pounds per brake horsepower and occupies a floor space of about 1 square foot or more per brake horsepower. The boiler-room weights of battleships equipped with watertube boilers average about 110 pounds per brake horsepower, while with Scotch boilers this figure is considerably increased. For ordinary cargo and passenger ships equipped with Scotch boilers the boiler-room weights do not run very much below 200 pounds per brake horsepower,

Generated on 2024-09-12 07:34 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

while the space occupied by watertube boilers is about one-third of a square foot per brake horsepower.

Gas producer plants designed especially for marine work can be built weighing from 75 to 90 pounds per brake horsepower, and occupying a floor space of from ¼ to ⅓ of a square foot per brake horsepower. Thus it is evident that the marine gas producer has a decided advantage both in weight and space occupied per brake horsepower over the steam plant. The only type of marine steam plant which offers greater advantage than the gas producer and gas engine in this regard is that used on torpedo-boat destroyers, where the fire-room weights are as low as 30 pounds per brake horsepower, and the space is only about ⅛ of a square foot per brake horsepower.

Coming to the question of the gas engine, we find that at the present time it is impossible to obtain engines much larger than 500 brake horsepower. Six cylinder, double-acting engines of this size, however, are of light weight, some being as low as 30 pounds per brake horsepower, whereas engine-room weights for a steam plant usually do not run much below 65 or 70 pounds per brake horsepower. The reason that larger engines have not been built is very largely due to the fact that a cheap fuel has not been available. The cost of operating engines of even 500 horsepower on gasoline is, in most cases, prohibitive. The development of a successful marine gas producer capable of using bituminous coal, which is now an assured fact, will undoubtedly give a decided impetus to the development of large marine gas engines; and there is every reason to believe that the success which has attended the development of engines up to 500 horsepower will be achieved in the development of larger engines.

The rapid development of large gas engines on shore has been in a direction entirely unsuited to meet the requirements of marine engines. Stationary engines of 5,000 or 6,000 horsepower are usually of the horizontal, twin-tandem, double-acting, four-cycle type, the maximum diameter of cylinders being about 44 inches. These engines, however, are very heavy, and massively built, their weights running from 300 to 500 pounds per brake horsepower.

Although the difficulties to be overcome in the design of marine engines are vastly greater than those which were encountered in the development of stationary gas engines, yet they are by no means insurmountable. Such questions as reservability, adequate cooling of cylinders, pistons and valves, satisfactory handling of the exhaust, governing, etc., have been satisfactorily met in stationary practice, and the majority of the gas-engine builders claim that practical solutions are available for these problems in the marine engine. One important advantage which the marine plant has over the stationary plant is that of a practically uniform load at full power. Many large stationary gas engines are now used in electrical plants to supply power for lighting and electric railways. In such plants the load varies widely from hour to hour through the day, and for certain periods of the day is extremely small. The changes are abrupt, but even under these conditions an actual economy from coal pile to switchboard of 1¼ pounds of coal per brake horsepower per hour has been achieved. Under the uniform conditions of load which woud prevail in a marine plant, it is confidently predicted that a brake horsepower can be developed on ¾ of a pound per brake horsepower per hour, making the percentage of heat available in the coal which is utilized in useful work at the propeller shaft considerably more than 17 percent. Another advantage of the gas plant over a steam plant on shipboard is the fact that no fresh water is required, as salt water can be used equally as well.

Loss of the "Republic."

At the present writing everything seems to point to the fact that the sinking of the *Republic* was due to the failure of her water-tight bulkheads. The ship was rammed in way of the engine space, and that compartment was, of course, immediately flooded. There was barely time for the engine-room staff to close down the water-tight doors and make their escape before the water had submerged the dynamos and plunged the ship into darkness. The engine room of the *Republic* is about 50 feet long and is located just abaft the center of the ship. The flooding of this compartment alone and the amount of water which found its way into the adjacent compartments before the water-tight doors could be closed would not have been sufficient to sink the ship, although as it was the engine-room compartment which was flooded, the ship was, of course, immediately rendered helpless by the submerging of her pumps and engines. The fact that the ship remained afloat forty and one-half hours after the collision and then finally sank rapidly, stern first, led the chief engineer to express the opinion that one of the bulkheads in the after hold was finally torn away. The exact conditions may never be known; but the effectiveness of water-tight bulkheads, except the forward and after collision bulkheads, as installed in the majority of modern passenger and cargo steamships will be questioned more than ever as a means of rendering a vessel non-sinkable. In commenting further on the accident, the chief engineer expressed the belief that if two good pumps had been available the ship could have been saved, or at least she would have been kept afloat until towed into shallow water. This suggests forcibly the value of building a divisional bulkhead in both the engine and boiler rooms, so that in the event of a collision of this sort part of the ship's pumps and engines and boiler capacity would be available. This is a question which, in view of the remote possibility of the bulkheads ever being needed, and the fact that bulkheads so placed add little to the structural strength of the ship, but add excessive weight, is debatable.

Generated on 2024-09-12 07:34 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

BATTLESHIPS.

	Tons.	Knots.		Dec. 1.	Jan. 1.
S. Carolina..	16,000	18½	Wm. Cramp & Sons.....	69.9	75.1
Michigan ...	16,000	18½	New York Shipbuilding Co...	79.4	85.1
Delaware ...	20,000	21	Newp't News S.B. & D.D. Co.	54.9	59.0
North Dakota	20,000	21	Fore River Shipbuilding Co..	62.8	67.4

TORPEDO BOAT DESTROYERS.

Smith	700	28	Wm. Cramp & Sons.....	59.9	62.8
Lamson	700	28	Wm. Cramp & Sons.....	58.5	61.8
Preston	700	28	New York Shipbuilding Co...	54.9	57.9
Flusser	700	28	Bath Iron Works.....	40.9	50.0
Reid	700	28	Bath Iron Works.....	38.5	48.5

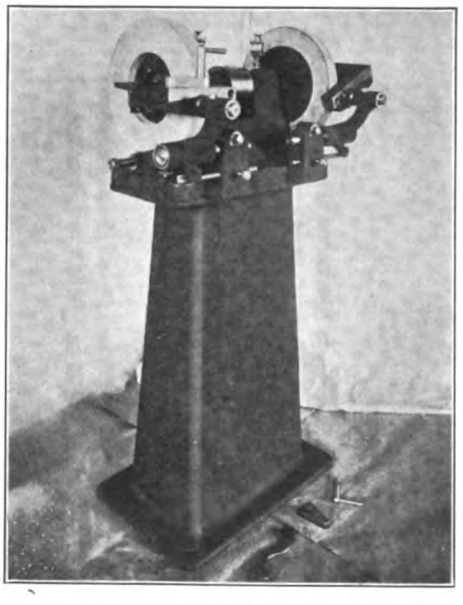
SUBMARINE TORPEDO BOATS.

Stingray	—	—	Fore River Shipbuilding Co..	64.5	68.0
Tarpon	—	—	Fore River Shipbuilding Co..	63.0	66.9
Bonita	—	—	Fore River Shipbuilding Co..	60.8	63.0
Snapper	—	—	Fore River Shipbuilding Co..	58.2	62.3
Norwhal	—	—	Fore River Shipbuilding Co..	54.8	58.7
Grayling	—	—	Fore River Shipbuilding Co..	53.5	57.4
Salmon	—	—	Fore River Shipbuilding Co..	52.8	54.9

ENGINEERING SPECIALTIES.

A Novel Face Grinding Machine.

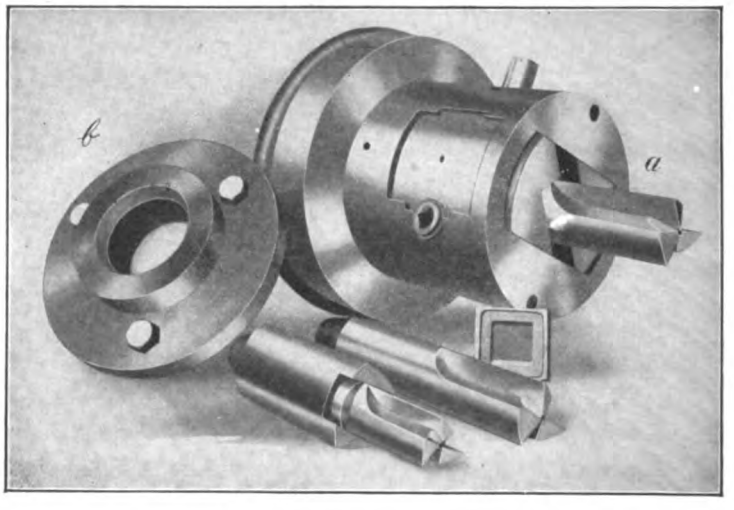
This machine is designed for grinding lathe and planer tools, for edge grinding and squaring up ends of work, and for the general miscellaneous small jobs of grinding in the tool room and in the shop. A straight edge or surface on tools and a straight face on the edges of work is much easier and more accurately obtained by using the face of the wheel, provided that face be straight and the wheel be of suitable character. Such a face cannot be obtained with an emery



wheel dresser nor can the diameter of the wheel be kept true with a dresser. Recognizing these facts, the manufacturers of this tool, the Emmert Manufacturing Company, Waynesboro, Pa., have provided a work table located in front of and extending by the edge of the wheel, so that both the face and edge of the wheel can be used for grinding. This table is located in a guide carried by a transversely swinging arm, and in the end of the arm a longitudinally adjustable diamond holder is located. Normally, the table can be either clamped, to prevent any transverse rocking movement, or adjusted to allow a certain amount of such movement, as is often an advantage in grinding wide work. When the surface of a wheel becomes dull or untrue an adjustable stop below the table is moved out of its path, and the table swung backward away from the wheel, at the same time swinging the diamond across the face of the wheel, so as to give the latter a good cutting and a straight surface. The table can also slide in a longitudinal direction in a guide, for truing off the edge of the wheel. The table guide is pivoted in the diamond-carrying arm, and can be set by means of graduations and clamped at any angle with the face of the wheel up to 45 degrees. Upon the table is also provided an adjustable squaring device or protractor, which may be set from 90 degrees to 45 degrees with the surface of the wheel.

A Triangular Bit for Boring Square Holes.

A tool has recently been placed on the market by the Radical Angular Drill Company, 114 Liberty street, New York, which, it is claimed, is capable of boring square holes with the same facility and with nearly the same speed that the ordinary twist or flat drill will bore a round hole in the same material. At the same time the tool, while not altogether as simple as the flat drill, is not complicated nor expensive, and is easily made or ground in the average machine shop. The only appliance needed for the use of this special tool upon such machines as lathes, drill presses and milling machines is a special chuck, which is really a device for making the three-cornered boring tool or bit travel about in such a way as to strike out a square hole in the work. It consists of a driving part which is screwed onto the spindle of the machine, a guiding part which either rides upon the first part, or else is secured permanently to the frame of the machine, and a third part, or socket, into which the shank of the drill is screwed. This third part is caused to rotate by the first part, but has a slight freedom of motion in relation thereto, being guided as to its exact movements by the matrix or frame in the stationary part. Where square holes are to be drilled the shank



of the tool is three cornered, the sides of the shank being formed by segments of circles struck from opposite corners as centers, the radius of these circles being the same and equal to one of the sides of the square hole which is to be drilled. The guide in the stationary part of the chuck is adjusted to the size of the hole to be drilled, that is, so that the sides of the square opening are just equal to the radius by which the circles used for striking out the sides of the shank are formed.

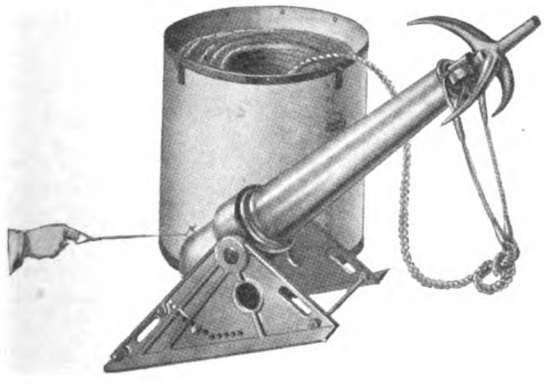
When one of the sides of the shank is either rolling or sliding upon one of the sides of the square guide, the opposite

Generated on 2024-09-12 07:30 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

corner of the shank will be moving in a straight line in contact with the opposite side of the guide. The corresponding corner of the head of the tool would at the same time strike out a straight line in the work. This motion takes place on all four sides of the guide, except for a little space at each corner, the result being that the hole is perfectly square except for a slight rounding at the corners. If it is desired to bore out a complete square with sharp corners, a special tool is employed, having a shank considerably larger than the head of the tool, one corner of the shank being rounded instead of angular. The exact form of this round-cornered shank has been worked out empirically and a complete set of templates made for the different sizes of tools apt to be required in actual practice. The tools for both the round-cornered and sharp-cornered squares can be ground by means of a special attachment to the ordinary grinding machine.

The Meyers-Rogers Self-Anchoring Life-Saving Projectile

For a good many years life-saving guns have consisted of small and unreliable cannon firing a small weight which carried a quarter-inch cord ashore. For the device to be of much value, it was, of course, necessary for someone to be on shore to make the line fast, and draw in a rope operating a breeches buoy. A new life-saving gun has recently been placed on the market by the Myers-Rogers Projectile Company, 17 Battery place, New York, in which the projectile anchors itself on shore without assistance, thus rendering the vessel independent of aid from land. This projectile is fitted with grapnels, which attach themselves firmly in earth or rocks, and carries a 2-inch manila rope, the whole outfit weighing only a few pounds more than the old-style apparatus. Since the rope is heavy enough to support a number of men, a breeches buoy can be quickly operated over it. The end of



the rope left on board the ship is tied to the highest point on the vessel, and a block reeved into it to which is attached the buoy. In operation the first man to be sent from the ship to the shore is a sailor, who takes with him, attached to the block of the breeches buoy a line, and, as he reaches the shore, he hauls in enough of this whip line to reach from the shore to the vessel, thus establishing an endless whip line by means of which the breeches buoy can be operated back and forth to convey passengers from the wrecked vessel to the shore. The breaking of the rope in firing the projectile is prevented by a heavy spring, a sliding ring and cable. It has been found that after having been fired fifteen times the rope does not show any wear. The cannon used is made out of forged steel, 2 inches thick at the breech, and has a margin of safety of 125,000 pounds. It can be handled by two men and transported to any portion of the vessel.

COMMUNICATION.

Jet Propulsion.

EDITOR INTERNATIONAL MARINE ENGINEERING:

The interesting problem of propelling vessels by means of a jet occupies a prominent place among many others unsolved, not because of the seeming impossibility or limited field of application, but simply for the reason that very little has been done in the way of experimenting, and even that very roughly and incompletely. Anyone will tell you that jet propulsion has no future and that complete failure was invariably the result of all experiments. Very few, however, will be able to state where and how these experiments were made and just how brilliant was the victory of the screw over its modest and silent opponent. Theories and formulæ have been advanced from time to time by eminent engineers, but by the way of illustration we give the following table of comparative tests made by the late Dr. Zeuner, with his usual thoroughness, the same boat being used in both tests:

	Screw. Sept. 5, 1891.		Jet. June 21, 1892.	
	Miles Per Hour.	H. P.	Miles Per Hour.	H. P.
Down stream...	10.77	25.31	11.24	22.25
Up stream.....	6.17	23.45	6.4	22.25

This table seems to show that, after all, the jet has a little advantage over the screw in both speed and power consumption. And yet this was the first and only test made in a more or less thorough manner. Dr. Zeuner's theory is not the only one that can be advanced on the subject. In fact, it has recently been pointed out that this theory actually contains a mistake, but at any rate his or any other theory is bound to be considerably simpler and easier than, for instance, that of the screw. Of course the difficulties of a theory should not necessarily constitute a disadvantage if only the theory itself is plausible and if the results obtained are in full accordance with those expected. But is really such the case? If the trial speed does not come up to that required by the contract, is it not customary to replace the propeller, altering the pitch one way or the other, regardless of all theories? And even so, does the efficiency of the screw really present something so exclusive as to prohibit any attempt of exceeding it? The screw propeller necessitates a heavy, slow-speed engine, heavy shafting is expensive and presents all sorts of interesting possibilities—racing, breaking off, etc. It is a well-known fact that sometimes three propellers give a better result than four, and perhaps two would give a still more encouraging performance.

Again, let it be remembered that only low-grade centrifugal pumps were used for jet propulsion, sometimes reversed parallel turbines, very clumsy and inefficient; with modern high-duty turbine pumps much better results would be possible. The efficiency of the old-time centrifugal pump must have been much less than 50 percent, since one of the German writers naively states that a pump of 50 percent efficiency or over is bound to solve the issue. The velocities required are not very great, and the total lift to be produced by the pump is exceedingly low, contrary to the prevalent layman's opinion. So that a turbine pump can easily be made to give an efficiency of 75 percent or more for these conditions. The pump can be driven by a small, high-speed steam (or producer gas) engine, and the extra piping required would probably weigh not more, and would certainly cost less, than the propeller. The impossibility of racing and the probable absence of vibrations make the jet propeller still more attractive. A fair investigation on a large scale is imperative, and a friendly exchange of experts' views in the columns of INTERNATIONAL MARINE ENGINEERING would be desirable.

Philadelphia. N. W. AKIMOFF.

Generated on 2024-09-12 07:33 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

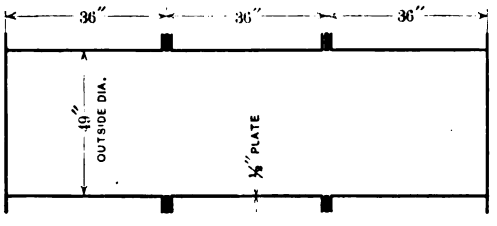
QUERIES AND ANSWERS.

Questions concerning marine engineering will be answered by the Editor in this column. Each communication must bear the name and address of the writer.

Q.—What is the correct formula for determining the safe working pressure on an Adamson furnace? What is Lloyd's formula for this?
C. B. S.

A.—The rule specified by the United States Steamboat Boiler Inspection Service is as follows:

$$P = \frac{C \times T^2}{L \times D}$$, where P = working pressure in pounds per square inch; $C = 89{,}600$, where the distance between rings is not more than 8 feet; T = thickness of plate in inches,



SECTION OF ADAMSON FURNACE.

which must not be less than 5/16 inch; L = distance between rings in feet, and D = outside diameter in inches. For the furnace shown in the sketch this formula figures out

$$P = \frac{89{,}600 \times (\frac{1}{2})^2}{3 \times 49}.$$

$P = 152.4$ pounds.

Lloyd's rule, where the length of a flat portion of the furnace, that is, the distance between flanges, is greater than 120 times the thickness of the plate, is

$$P = \frac{1{,}075{,}200 \times T^2}{L \times D}$$, but where the length of the straight portion is less than 120 times the thickness of the plate;

$$P = 50 \times \frac{(300\ T - L)}{D}$$, where D = outside diameter in inches; T = thickness of plate in inches; L = length of plain cylindrical part in inches, measured from the commencement of the curvature of the flanges of the furnace where the rings are fitted. For the furnace in the sketch, $120 \times T = 60$ inches. This is greater than the length of one section of the furnace; and, therefore, the second formula should be used. Since the length of one section of the furnace is 36 inches, the length of the straight portion of the furnace between the flanges would be about 33 inches. The formula would work out as follows:

$$P = 50 \times \frac{(300 \times .5 - 33)}{49}.$$

$P = 119.4$ pounds.

MR. JAMES DONALD, who has been naval architect for the New York Shipbuilding Company, Camden, N. J., for the past eight years, or since the formation of the company, is now established at 17 Victoria street, London, S. W., as a consulting naval architect. Mr. Donald was formerly connected with the Fairfield Shipbuilding & Engine Company, Glasgow, as assistant to Dr. Elgar in their London office, and with the Union Iron Works, San Francisco, Cal., as naval architect.

TECHNICAL PUBLICATIONS.

Steam Boilers. By Prof. C. H. Peabody and Edward F. Miller. Size, 5¾ by 9 inches. Pages, 420. Figures, 175. New York, 1908: John Wiley & Sons. Price, $4.

The former edition of this book, published in 1897, has become so well known as a standard textbook on the subject of steam boilers that little need be said regarding that part of the book, which is a repetition of the former edition. In the new edition a considerable amount of new material and many new illustrations have been added. While the number of subjects treated, and the order in which they are taken up have not been greatly changed, yet each chapter has been added to and revised to bring the work up to date. A chapter has been added on superheaters, in which the various types of superheaters now in use are illustrated and described. The best materials for use as steam-pipe fittings for superheated steam are considered. Considerable additional matter is given on the subject of steam piping, including the strength and expansion of pipe, the bursting point of extra heavy flanged fittings, the area of steam pipes, the flow of steam in pipes, and, finally, pipe coverings. A number of valuable tables, giving the dimensions and floor space occupied by different types of boilers and of economizers, have been added to the appendix. Other valuable features of the book include a comprehensive treatment of the subjects of fuel and combustion, corrosion and incrustation, a detailed description of the method of testing boilers, including gas analysis, measurement of air used, temperatures, etc. The principles and methods explained in the early chapters of the book are finally brought together and illustrated by applying them to the complete design of a horizontal tubular boiler.

Pumps (*Power* Hand-Book Series). By Hubert E. Collins. Size, 4½ by 6¾ inches. Pages, 99. Figures, 35. New York, 1908: Hill Publishing Company. Price, $1.

One of the most important auxiliaries in any power plant, whether on board ship or on land, is the boiler feed pump. Every engineer must be thoroughly familiar with this small engine, and must be able to hunt out troubles and remedy them with dispatch. Many instances related in this book will be found of value to engineers who have trouble with their pumps. About half of the book is taken up solely with the subject of pump troubles. Valuable information is given on the subject of setting the valves of a duplex pump; finding the horse-power of a pump, and setting up and operating pumps. At the end of the volume a number of pages of useful tables are given, including heights in feet to which pumps will lift water; friction loss in pounds pressure per square inch; horizontal and vertical distances reached by jets; pressure of water, areas of circles, etc.

The Star Improved Steam Engine Indicator. By George H. Barrus. Size, 4½ by 7¼ inches. Pages, 140. Figures, 23. Boston, 1908: The Star Brass Manufacturing Company.

Although this treatise was prepared especially to describe one particular make of indicator, it cannot be considered as solely an advertisement for the new indicator; for it is an impartial statement of the entire subject of indicator work, including chapters on descriptions of the details of the Star improved indicator, and afterwards a careful consideration of indicator diagrams, the mehods of working up the diagram, the use of the planimeter, and the computation of horsepower and steam accounted for by indicator diagrams. A part of the book is also devoted to the discussion of the subject of cylinder condensation and leakage, and the methods of combining indicator diagrams taken from multiple expansion engines. Numerous sample cards are shown, and the necessary tables for use in the computations involved are given.

Generated on 2024-09-12 07:28 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

The Girl and the Motor. By Hilda Ward. Size, 4½ by 6¾ inches. Pages, 120. Illustrations, 5. Cincinnati, 1908: The Gas Engine Publishing Company. Price, $1.00.

This story is the result of the experiments of the author, a mere girl, who buys a small motor boat and later a 20-horse-power automobile. Without any previous experience with gasoline engines, she naturally meets with situations that call forth all the inventive temperament available. The remedies that occur—for instance, the employment of "buttonholes for bolts to go through"—are often unique. While this is not primarily a book of information on gas-engine troubles, yet neither has it the plot of a novel. It simply describes a series of interesting experiences in an entertaining way.

Shaft Governors (*Power* Hand-Book Series). By Hubert E. Collins. Size, 4 1/3 by 6¾ inches. Pages, 127. Figures, 35. New York, 1908: Hill Publishing Company. Price, $1.

Technical books covering exhaustively the subject of shaft governors are rare. The fact that this book is intended to cover this subject completely from a practical standpoint should make it of value to operating engineers. An interesting history of the evolution of the shaft governor is given, describing the various types, both centrifugal and inertia, which are now in general use. Definitions and rules covering the necessary terms form the subject matter of the second chapter, while succeeding chapters take up the subject of the adjustment of various types of governors, leading up finally to a consideration of steam turbine governors. The text is well illustrated and clearly written, so that the entire subject, which is usually considered somewhat complicated, is set forth in a comprehensible manner.

SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

898,551. BOAT PROPELLER. LORENZO C. BUTLER, ARION, IA.

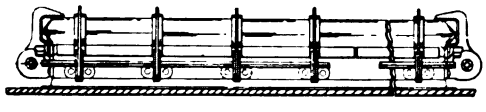
Claim 1.—In combination with a boat having a rod supported by the opposite walls thereof, oscillating levers mounted upon said rod, a rudder, an angled lever connected to the rudder shaft, rods connecting the arms of said angled lever with said oscillating levers, longitudinal movable rods pivotally connected to the lower ends of the oscillating levers, the forward ends of said rods being bent to form foot rests. Four claims.

902,996. SHIP-PROPULSION SYSTEM. CHARLES ALGERNON PARSONS, OF NEWCASTLE-UPON-TYNE, ENGLAND.

Claim 1.—A ship-propulsion system comprising in combination a propeller shaft, reciprocating engine means connected to said propeller shaft, a separate shaft, turbine means on said separate shaft and receiving working fluid from said reciprocating engine means, together with means for transmitting power from said separate turbine shaft to said propeller shaft. Fourteen claims.

904,275. HATCH-FASTENING DEVICE. ORTEN PETERSON PECKHAM, OF RIVER ROUGE, MICH.

Claim 1.—In a hatch-fastening device the combination with a plurality of movable clamping hooks adapted to engage the hatch cover,



means for simultaneously actuating said hooks to carry them into engagement with the cover, and means for simultaneously locking said hooks against outward or backward movement. Nine claims.

904,135. SPEED-INDICATOR OR LOG FOR SHIPS. HEINRICH G. A. KLAPPROTH, OF HANOVER, GERMANY.

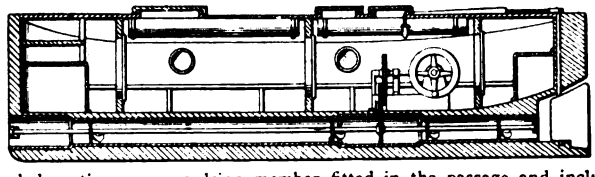
Claim 2.—In a speed-testing mechanism for ships, the combination, with the hull of a ship, of a bracket, a cylinder secured in said bracket, a fluid, in said cylinder, a piston rod and head slidably arranged in said cylinder, a speed-indicating mechanism, a concave disk rigidly secured to the free end of said piston rod adapted to offer a resistance to the water through which the ship passes so as to exert a pressure upon said fluid and by means of said fluid distributing said pressure to said speed-indicating mechanism. Five claims.

904,285. MARINE PROPULSION. WILLIAM P. THOMPSON, OF LIVERPOOL, ENGLAND.

Claim 2.—A vessel and a series of long, narrow supporting fins or hydroplanes having their inner ends connected to the body of the vessel on each side of the center line and extending beyond the gunwale, said fins being disposed at short intervals for nearly the entire length of the vessel, whereby every part of the vessel is supported. Thirty-two claims.

904,372. LIFE-BOAT. JOHN H. STOELT, OF SEBEWAING, MICH.

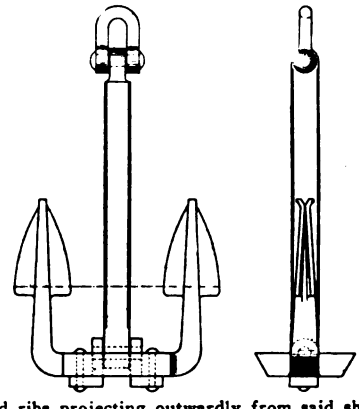
Claim 1.—In a life-boat a cylindrical body, an elongated keel member having a longitudinal tubular passage provided at intervals with ex-



panded portions, a propulsion member fitted in the passage and including a spur wheel arranged in one of the expanded portions of the passage, and cross bars constituting bearings for the propeller shaft disposed adjacent to the expanded portions. Five claims.

906,023. PALM FOR STOCKLESS ANCHORS. FRIEDRICH HEUSS, OF MANNHEIM, GERMANY.

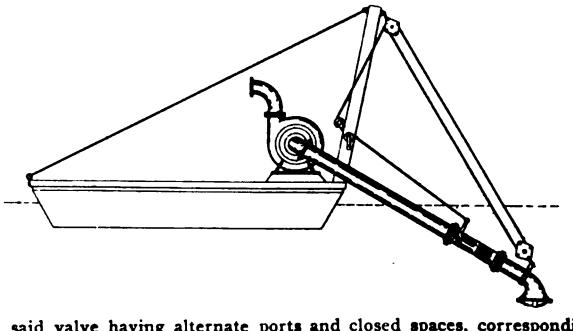
Claim.—A palm for stockless anchors, comprising two curved inclined ribs projecting inwardly toward the shank of the anchor, and two



curved inclined ribs projecting outwardly from said shank, the ends of said ribs forming a divided point of application. One claim.

906,234. SUCTION DREDGE OR THE LIKE. FRANKLIN H. JACKSON, OF BERKELEY, CAL., ASSIGNOR TO BYRON JACKSON IRON WORKS, OF WEST BERKELEY, CAL., A CORPORATION OF CALIFORNIA.

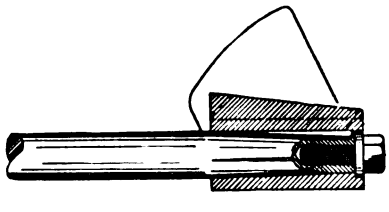
Claim 1.—The combination with a dredge, and the tubular suction pipe thereof, of a valve guided and turnable upon the exterior of the



pipe, said valve having alternate ports and closed spaces, corresponding ports in the suction tube, and means by which the valve ports may be registered with those of the pipe. Five claims.

906,337. PROPELLER WHEEL. ROBERT THALER, OF BAY CITY, MICH.

Claim 2.—The combination of a propeller hub, the bore of which is tapered from end to end, and is provided with channels whose ends



merge into the larger end of the bore, a shaft tapered at one end, keys on the tapered end, the keys at one end merging into the shaft, and means for securing the shaft and hub against relative longitudinal movement. Eight claims.

906,846. BATTLESHIP PROTECTION BY MEANS OF CONCRETE. LORENZO D'ADDA, OF TURIN, ITALY.

Claim.—An armor, comprising an outer metal wall, an inner metal wall, a plurality of intermediate partitions, concrete layers between the said partitions and the partitions and the said walls, of a hardness progressively increasing from said interior metal wall to the said outer metal wall. One claim.

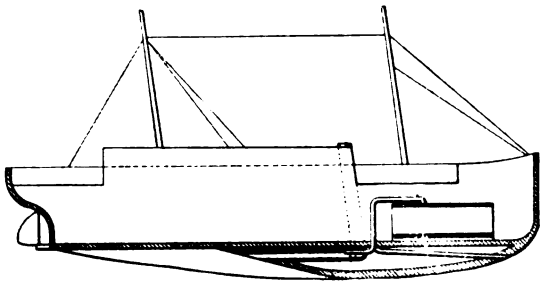
Generated on 2024-09-12 07:33 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

906,716. MEANS FOR RAISING SUNKEN VESSELS. NICOLA JELPO, OF NAPLES, ITALY.

Claim 1.—An apparatus for raising sunken vessels, comprising a cylindrical inflatable bag, a wire netting inclosing said bag, the bottom of said netting being formed into a loop, an iron bar placed on each side of said loop, means for clamping said bars together, ropes attached to said clamping means, and means for inflating said bag after the same is sunk. Two claims.

907,086. PROPELLING MEANS FOR VESSELS. WALFRID TH. NASELIUS, OF KENNEDY, MINN.

Claim 1.—The combination of a hull having a central keel extending longitudinally from the bow to midship and terminating at its rear in an upwardly-inclined surface, an injector discharging rearwardly and

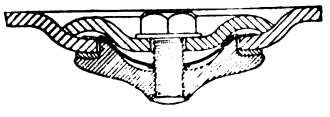


terminating in the said inclined surface, side keels disposed parallel to each other with their front ends disposed at opposite sides of the central keel and in overlapping relation to the rear end of the latter, an air pipe disposed within the hull with its lower end connected with the injector and its upper end open to the atmosphere, and means for supplying fluid under pressure to the injector. Two claims.

British patents compiled by Edwards & Co., chartered patent agents and engineers, Chancery Lane Station Chambers, London, W. C.

13,800. MAN-HOLE DOORS. W. A. SMITH, DERBY.

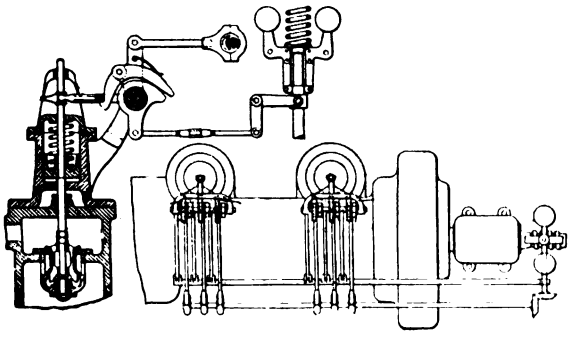
The invention is intended chiefly for use with range boilers, but is applicable generally. The opening is formed in a depressed part of the



shell of the boiler, and is closed by inner and outer covers. A cross-bar threaded on the securing-bolt holds the inner cover on its seat while the outer cover is being secured.

13,583. TURBINES. F. HODGKINSON.

A normal and overload puff-governing mechanism for elastic-fluid turbines is shown. The governor controls a normal-load valve in the primary inlet and an overload valve in the secondary inlet, the valves being operated by similar gearing set progressively. Each valve has collars on its spindles with which the projecting end of a widely-forked lever engages, and hooked levers are adapted to engage with the forked lever.



The hooked levers are carried by rocking levers reciprocated by eccentrics, and are controlled by progressively-set cams connected to a rocking shaft adjusted by the governor. The arrangement is such that the hooked levers in their oscillations successively engage with the forked lever of the normal-load valve as the load increases, and increase the valve opening until that valve is working at its full capacity; the overload valve is then similarly operated, and vice versa.

13,975. SCREW PROPELLERS. W. MITCHELL, T. B. KEEDY, SOUTH SHIELDS.

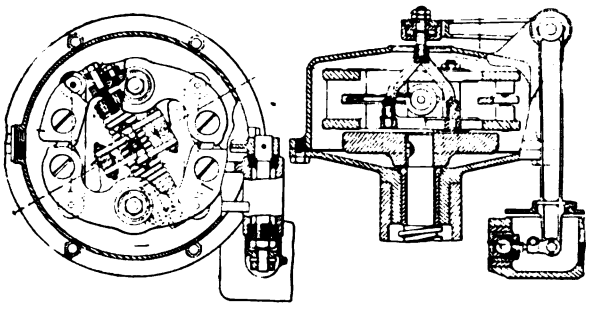
In order to increase the propulsive effect of screw propellers, the root portion of each blade is set in a plane more nearly at right angles to the axis of the boss than the plane of the outer or more effective portion. The overhanging portions are strengthened by supports.

13,921. TURBINES. W. CLARK, GLASGOW.

A hollow cylindrical or conoidal drum carries a series of outward-flow blades which co-operate with standing blades fixed to the casing. The motive fluid flows in a serpentine manner along the turbine. A multiple leakage-preventing device is arranged at the high-pressure end of the drum, and the fluid which leaks past this device is utilized in the lower-pressure stages. Ring packings prevent the leakage of steam at the spaces between the fixed and running blades.

14,684. TURBINES. WARWICK MACHINERY CO., LONDON.

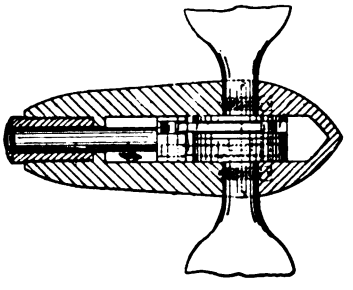
Relates to the governing mechanism for the admission valves of certain elastic-fluid turbines, and consists in modifications in the general arrangement and in detail construction of the shaft governor. The governor is mounted upon an auxiliary shaft which is driven from the main shaft by worm gearing. The movement of the governor is imparted to a spindle, a collar on which rotates between thrust plates in a casing which is pivoted between the branches of the forked arm of a bell-crank lever.



The other arm of the lever carries a pin having a spherical end socketed in a bearing in the end of the eccentric shaft, which actuates the valve-operating dogs, to transmit to it axial movement according to the movement of the governor for the purpose of engaging or disengaging the valve-rods and the dogs. The governor comprises two masses pivoted and held in opposition to the centrifugal force by a single spring. The masses are provided with lugs so that the oppositely moving ends interlock at a maximum speed. The angular movement of the masses is transmitted to the spindle by links.

15,353. SCREW PROPELLERS. T. THOMPSON AND VILLINGER'S PATENT REVERSIBLE PROPELLER SYNDICATE, LONDON.

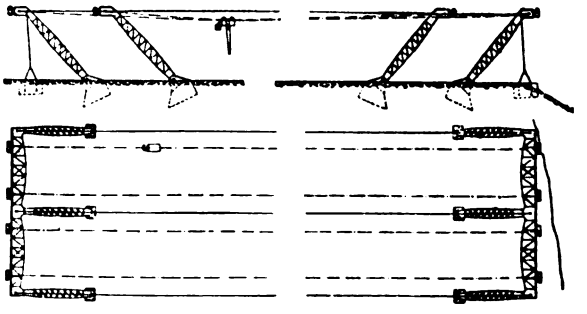
In reversible propellers in which the blades are operated or reversed while in motion by a central rod sliding in the hollow driving shaft, the rod is operated by a screw-and-nut mechanism designed to move the rod smoothly and evenly and to retain it in any position. The central rod is connected to a brush which is loosely mounted on the hollow driving



shaft and is provided with a projecting collar. This collar engages with the ends of a threaded sleeve moved longitudinally by a nut caused to rotate in a fixed bearing. An extension of the sleeve is flattened on both its side faces, which engage between forks of the main bearing bracket so as to prevent rotation of the sleeve. To facilitate the operation of the blades and to prevent cross winding, the inner ends are enlarged at their adjacent faces bearing against each other, and one being provided with an axial pin fitting in an axial recess in the other. Slots are cut for the operating rods.

16,526. SHIPBUILDING SLIPS. DUISBURGER MASCHINENBAU-AKT.-GES. VORM. BECHEM & KEETMAN.

Relates to cable traveler installations for slipways, and consists in the arrangement of adjacent slipways with a view to economize space. The



adjacent supports are arranged in a straight line, but relatively staggered; or a common support is employed. The former is particularly useful when the slipway makes an acute angle with the water's edge.

16,991. GAS TURBINES. S. KOWACZEK, BAHNHOF, ZABRZE, GERMANY.

In apparatus of the type in which the driving-fluid acts on pockets in the circumference of a rotary disk the explosive mixture is driven into the explosion chamber by pumps driven directly from the main shaft. The disk is partly surrounded by a casing provided with an explosion chamber whence a tangential passage leads to the circumference of the disk. Explosive mixture is supplied to the chamber through a pipe fitted with a non-return valve, by pumps driven by eccentrics on the main shaft, and a vaporizer. The ignition mechanism is actuated by tappets on the disk. A spring-controlled valve is placed between the chamber and the passage to the disk.

Generated on 2024-09-12 07:34 GMT / https://hdl.handle.net/2027/mdp.39015080009809
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN